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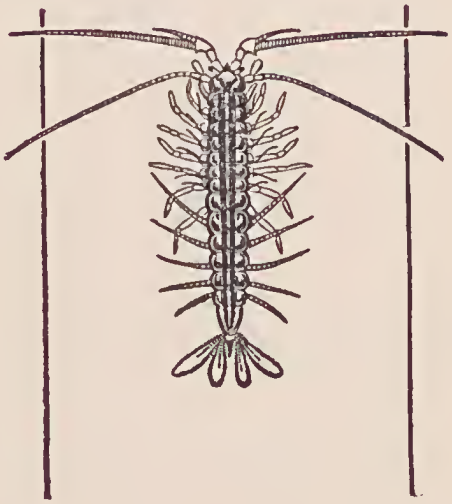

NATIONAL MUSEUM
- 4 AUG 1972
OF VICTORIA

Edited by
W. F. ELLIS
Director of the Museum

PUBLISHED BY THE MUSEUM COMMITTEE
LAUNCESTON CITY COUNCIL

NUMBERS 31 - 40

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FOOT & PLAYSTED PRINT-F&P 75122

No. 31.

RECORDS OF THE QUEEN VICTORIA MUSEUM LAUNCESTON

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ABORIGINAL BONE IMPLEMENT FROM FOSSIL BONE BED, TASMANIA

by

EDMUND D. GILL,

National Museum of Victoria.

Manuscript received 4/8/67. *Published 29/3/68*

Flowery Gully is a small settlement on the west side of the Tamar Estuary, about four miles south of Beaconsfield, and 22 miles (in a direct line) northwest of Launceston. Gordon Limestone of Ordovician age forms the bedrock, and this has been quarried in a number of places. When visiting Launceston in 1952, it was reported to me that fossil bones had been discovered in Beams' Quarry at Flowery Gully (See Plate 1). The Director (then Miss I. J. Thomson) and Anthropologist (Mr. W. F. Ellis, now Director) of the Queen Victoria Museum and Art Gallery took me to the site S.E. of Mr. R. Beams' house and east of the road to Beaconsfield. The locality is mapped as B.L.P. Quarry by Hughes (1957).

The quarry revealed a face of some 20 feet of crystalline limestone with karst features. Stalactites, flowstone and other forms of secondary carbonate were noted. At the base of the section revealed in the quarry wall was a formation of red earth. Between five and six feet above the quarry floor in this formation was a horizontal bed containing considerable numbers of animal bones and some charcoal. The cave earth was present both above and below the bone bed. The bed was too even in fabric and too horizontal to be a collapse deposit. The occurrence was interpreted as a fissure or cave in which the bones had accumulated initially or had been washed in. The former explanation was considered more likely because of the wealth of bones limited to a narrow stratum. The structure of the deposit suggested an aboriginal midden rather than an animal lair, but the nature of the occurrence could not be determined in the brief time available. A sample of the deposit was taken, and washed upon return to Melbourne. This revealed an aboriginal bone implement, the occurrence of which was reported to the Queen Victoria Museum at Launceston with the recommendation that more of the deposit be collected. This recommendation was carried out but no further implements were found. However, the bones are beautifully preserved, so palaeontologically valuable. A photograph in the Hobart Mercury of June 4th, 1951, shows Mr. E. O. G. Scott and Mr. T. E. Burns collecting fossil bones in the cave before it was disturbed. The sample collected by me was from a section through the cave deposits that resulted from quarrying operations.

FOSSILS

Having learnt that Mr. E. O. G. Scott of Launceston had already made a collection of bones from this site, I invited him to prepare a faunal list from his collection, the fossils in the Queen Victoria Museum, Launceston, and those in the National Museum of Victoria, Melbourne. His determinations are given below, in addition to some further determinations by Mr. J. A. Mahoney (marked *), and one from Mr. A. R. McEvey (marked **), plus notes on local occurrence by Mr. R. H. Green (see also Kershaw 1952).

AVES	***Phaps chalcoptera* (Lamarck, 1790)	Rare
MONOTREMATA	*Tachyglossus setosus* (Geoffroy, 1803)	Plentiful
MARSUPIALIA	**Macropus major* (= *tasmaniensis*) (Shaw, 1800)	Now absent from district
	**Wallabia rufogrisea* (Desmarest, 1817)	Plentiful
	Thylogale billardieri (Desmarest, 1822)	Plentiful
	Potorous tridactylus (Kerr, 1792)	Plentiful
	Bettongia cuniculus (Ogilby, 1838)	Plentiful
	Trichosurus vulpecula (Kerr, 1792)	Plentiful
	Pseudocheirus convolutor (Oken, 1816)	Plentiful
	**Cercartetus nanus* (Desmarest, 1818)	Apparently absent
	Isoodon obesulus (Shaw & Nodder, 1797)	Plentiful
	Perameles gunnii (Gray, 1838)	Plentiful
	**Antechinus swainsoni* (Waterhouse, 1840)	Apparently absent
	**A. minimus* (Geoffroy, 1803) or	Absent
	Sminthopsis leucopus (Gray, 1842)	Rare
	**Dasyurus viverrinus* (Shaw, 1800) or	Rare
	Dasyurops maculatus (Kerr, 1792)	Rare
	Thylaeinus cynocephalus (Harris, 1808)	Absent
	Sarcophilus harrisii (Boitard, 1841)	Rare

PLACENTALIA	**Mastacomys fuscus* (Thomas, 1882)	Absent
	Pseudomys higginsi (Trouessart, 1897)	Absent
	**Rattus* sp. *R. lutreolus* (Gray, 1841) [including *Mus velutinus* Thomas, 1882].	Plentiful
	**Nyctophilus* or *Chalinolobus* sp.	The former plentiful, latter rare.
	**Glischropus (= Falsistrellus) tasmaniensis* (Gould, 1858)	Not recorded
	**Pseudomys cf. novaehollandiae* (Waterhouse, 1843) [= *Gyomys* or *Leggadina* sp. in Green, 1967].	Not extant in Tasmania
MOLLUSCA	*Caryodes dufresnii* (Leach, 1815)	Common
	Strangesta ruga (Legrand, 1871)	Common

Mr. Green adds that his collection also includes numerous maxillary remains of small reptile species. It is interesting to compare the two collections. No *Petaurus breviceps* was found which may support the argument that this species was introduced from Victoria.

BIOGEOGRAPHY

Research on monotremes by Mr. J. A. Mahoney of the University of Sydney and myself has shown that the New Guinea echidna *Zaglossus* was present across the Australian mainland and in Tasmania during the Pleistocene, but later in that period disappeared so that *Tachyglossus*, a genus suited to drier environments, alone remained. The evolution of the species of *Tachyglossus* has not yet been worked out, but the Tasmanian species apparently owes its identity to isolation on that island. It is probably only 12,000 years since Tasmania possessed a land bridge to the mainland. This appears to be too short a time in which to evolve such a well defined species. If a number of fossil sites like that at Flowery Gully can be dated, it will be possible to study variation against time, and determine how much change has taken place in the past 12,000 years.

Thylacinus was also widely distributed over the mainland as well as in Tasmania during the Pleistocene, but it is now extinct or limited to the more inaccessible parts of Tasmania. *Thylacinus* is the largest of the known Australian marsupial carnivores, and was relatively common in Tasmania until early in this century when it suddenly became rare, perhaps as a result of an epidemic. The diseases of placentals introduced into this country are mostly too specific to be the cause, but this subject has yet to be fully investigated. Evolutional studies have still to be done on this genus, and it will be interesting to discover if the degree of variation against time is similar to that in *Tachyglossus* or that in *Macropus major* wherein only varietal changes have occurred.

Sarcophilus was present on the mainland up to 5000 years ago (Gill 1967) and probably much more recently than that, judging by the occurrence of bones in middens that appear to be of much younger age.

The rat kangaroos are represented by two species :

1. *Bettongia cuniculus*, a species restricted to Tasmania, and in ecology favouring grassy areas or stony outcrops on the edge of forests, as at Flowery Gully. The species is very close to *B. gaimardi* so much so that Wakefield (1967) believes it should be a subspecies of *gaimardi*.

2. *Potorous tridactylus*. When Europeans first came to Australia, this species was common in S.E. Australia but is now represented chiefly by the Tasmanian form. It may be that the natural process was a gradual diminution of the distribution until it remained in Tasmania only (as with other species already named), and that the process was hastened by human occupation, or perhaps its disappearance on the mainland is due to the imported fox, which does not exist in Tasmania. Some regard the Tasmanian *Potorous* as a subspecies of *tridactylus*, viz., *apicalis*.

The wallaby *Thylogale billardieri* is essentially a Tasmanian form but is found also in Southern Victoria. One early record from Mount Gambier extends the distribution just over the South Australian border. This wallaby frequents gullies such as that where Beams' Quarry is situated. The species was very numerous in the early days of European occupation, and appears to have been an important item in the nutrition of the Tasmanian aborigines.

The bandicoots are represented in the Flowery Gully fauna by two species :

1. *Isoodon obesulus*, the short-nosed bandicoot of very wide distribution in Australia. The Tasmanian form is slightly different but is not considered to have attained subspecific status.

2. *Perameles gunni* is a species of barred bandicoot found in Tasmania and a small area of S.W. Victoria. Insects and vegetable matter of various kinds constitute its diet.

The fossils include two possums :
1. *Pscudocheirus convolutor*, the specific status of which is questioned by many.
2. *Trichosurus vulpecula*, the very widely distributed brushtail possum, and the most adaptable of all Australian marsupials.

Indeed its occurrence over so vast an area as the Australian continent, and its acceptance of such varied sites for its nests as holes in trees, burrows in creek banks, ceilings of houses, indicates it to be the most resilient of all our native mammals.

The placental *Pscudomys higginsi* occurs widely in Tasmania, to which island this rat is limited.

PALAEOECOLOGY

The mammal fauna thus includes one monotreme, nine marsupials and one placental. The nine marsupials include two carnivores, while the remaining seven are herbivorous or of wider food habits. Ground and tree living forms occur; they inhabited forests or forest margins. A number of babitats is represented. All these animals did not live in the eave (or fissure) or just above the eave where their bones could be washed in, but were gathered from a range of localities. The gatherer was an animal predator or man. The fabric of the deposit suggested a midden rather than an animal lair, and this interpretation was supported by the finding of an aboriginal bone implement.

CHRONOLOGY AND CLIMATE

Radiocarbon dating had not been introduced into Australia when the sample was collected. However, some charcoal was retained as part of a matrix sample. This was not quite sufficient in weight for a radiocarbon assay, so the organic fraction of some bone fragments was added to make up the required amount. Professor K. Kigoshi of Gakushuin University, Japan, made the determination, reporting the age as 7080 $\pm$ 420 years B.P. (Gak-967).

Seven millenia ago the Wisconsin (Wurm) glaciers had retreated and the climate was not very different from the present. In a number of places in the world (including Australia) organic sedimentation had resumed in mountain tarns after the retreat of the ice. The sea was returning to its present order of level after its retreat from the continental shelves during the Last Glaciation (Fairbridge 1961). Thus at Badger Head on the north coast of Tasmania, stumps of small trees between present tide limits gave a radiocarbon date of c. 7380 years B.P. This period preceded the postglacial thermal maximum when the climate was warmer and drier in southern Australia, as is shown by lower lake levels, dessication of lake floors with building of parna dunes, and such like. These processes were particularly apparent in marginal areas, but were also well marked in Victoria (Gill 1953, 1964) and northern Tasmania (Nicolls 1958, Stephens and Crocker 1946).

Radiocarbon dates up to 8,700 years B.P. have been obtained for Tasmanian aboriginal sites, but it may be anticipated that older ones will be discovered.

BONE IMPLEMENT

The implement is the tip of a bone awl, reg. no. 49246 in the anthropological collection of the National Museum of Victoria, (Pl. 2-5). It is 4.3 cm. long and at its widest 1.3 cm. The thickest part of the broken end (away from the point) is 3 mm. The tabula of the bone from which it was made is present on three of the four sides of the broken end, while the fourth side, and the broken end itself, is completely occupied witb cancellous bone. The convexity of the side of the bone carrying the registered number, and the concavity of the opposite side, indicate that the implement was made from the flattish fibula of the type found in macropodids, and belonging to an animal the size of a kangaroo. It is not made from a human fibula because such are not flattened. The flattening of the macropodid fibula is at the distal end, and is accommodated to tbe curvature of the contiguous part of the tibia. This planate part was often used by the aborigines of both mainland and Tasmanian races for making awls, *muduks*, and nose bones. That the tip of the awl consists of compact bone indicates from which part of the distal end of the fibula it was made, viz., that part where the eancellous bone cuts out.

The convex side of the implement and the tip have been roughly pared and then partly smoothed. If the tip of the implement were originally symmetrical, as one would expect, then it has been broken longitudinally since it was made, but judging from the polish on the broken edges, especially towards and at the tip, the implement was used extensively after it was broken. Moreover, the break transversely across the implement is a comparatively recent one, so that it can be inferred that originally the implement was longer, and broke transversely after it broke longitudinally. Indeed the break is so fresh that it probably took place during the working of the deposit. Crowther (1925) and Meston (1949) have described bone awls from Tasmania. As the full width of the fibula was apparently used when the Flowery Gully implement was first made, it would be too wide for a nose bone and too big for a *muduk*. It can be accepted as the remains of an awl, which conclusion would be in keeping with such implements already known from Tasmania.

ACKNOWLEDGMENTS

Mr. W. F. Ellis, Mr. E. O. G. Scott, and Miss Joan Dixon kindly provided information.

Mr. M. R. Banks checked the site and provided the photo herein. The photos of the implement were taken by Mr. Frank Guy.

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B.L.P. Quarry at Flowery Gully, looking east from hill south of Mr. R. Beams' house. Photograph by Mr. M. R. Banks, 1967.

Piece of aboriginal bone awl from the Flowery Gully cave bone bed, x 2 approximately. Views from the four sides. Photograph by Mr. Frank Guy, Royal Melbourne Institute of Technology, Department of Photography.

No. 32

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THE MURIDS AND SMALL DASYURIDS IN TASMANIA

Parts 3 and 4

by
R. H. GREEN,
Queen Victoria Museum, Launceston

Manuscript received 1/7/67. *Published 24/6/68.*

Part 3. *Pseudomys higginsi* (Trouessart)

ABSTRACT

The results of three years' (1963-1965) collecting and field observations on the long-tailed rat *P. higginsi* are recorded.

The localities from which specimens have been collected are given and the extent of distribution, based on habitat is mapped and described.

A full description, based on 68 recently collected specimens is given, together with tabulated measurements of plastic features and skulls. Notes are given on habits, activity, choice of nesting sites, the invasion of buildings, diet and faecal pellets.

Breeding has been found to be seasonal, the young being born between mid-November and mid-March with three being the usual litter. Some details are given of embryonic features and development. Three litters have been born in captivity from which the newly born young are described and growth and development detailed. Sexing by scrotal pigmentation has been found possible from an early age. Some notes are given on the occurrence and progress of sub-adult moult.

Methods of trapping, catch expectancy, damage to and predation of trapped rats and the associated small mammal species are discussed. A series of ectoparasites has been collected and some determinations are tabulated. Some results of laboratory tests for diseases are given. The influence of natural predation and the effects of fire and milling operations are discussed.

DISTRIBUTION

Pseudomys higginsi has now been collected from numerous localities in Tasmania ranging in altitude from near sea level to about 3,000 feet. All known occurrences have been in or near rainforest and its stronghold is in the extensive rainforests in the western half of the island.

In addition to the series personally collected from near Cradle Mountain and Waratah in the western highlands, and Corinna near the west coast, the Queen Victoria Museum holds specimens from Magnet, Port Davey on the south-west coast, Mount Barrow in the central north-east, and Golden Valley in the Great Western Tier. The Tasmanian Museum holds specimens from Port Davey, St. Valentine's Peak in the western highlands, Lunawanna on Bruny Island, Mount Wellington, and the Arve River in southern Tasmania. B. C. Mollison (pers. comm.) records its occurrence in the Styx and Florentine Valleys, at Lake Fenton in the central south, and in a deep wet gully at the foot of the Great Western Tier in the midlands.

Its distribution illustrated in figure 6 is based on the distribution of its preferred habitat within which are shown the location from which specimens have been collected. Much of the rainforest in western Tasmania is broken up with areas of open sedgeland. As these openings vary greatly in extent and distribution it has not been practicable to exclude them in the figure and the shading includes communities other than rainforest which occur within its overall limits. Some isolated patches of rainforest which have not been sampled are included: from experience it is to be expected that they would be inhabited by *P. higginsi*.

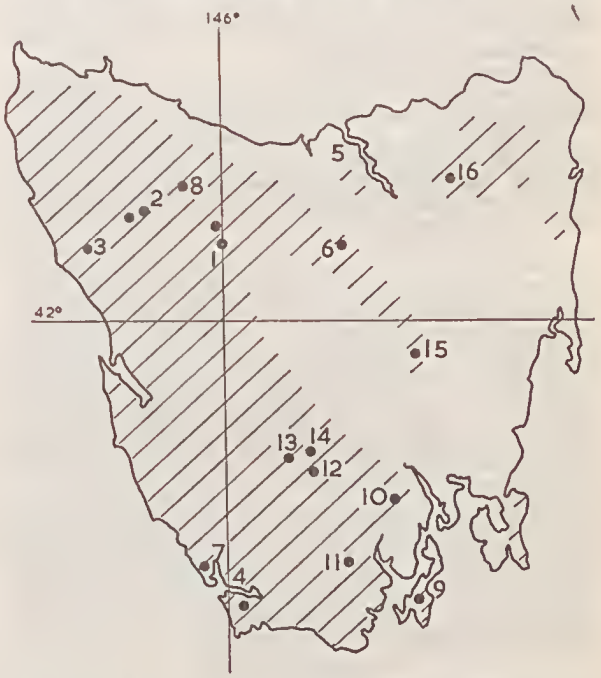

FIGURE 6.
Localities from which *P. higginsi* has been collected and the probable distribution based on habitat. Places mentioned in the text are: 1. Cradle Mountain, 2. Waratah, 3. Corinna, 4. Port Davey, 5. Flowery Gully, 6. Golden Valley, 7. Bond Bay, 8. St. Valentines Peak, 9. Lunawanna, 10. Mount Wellington, 11. Arve River, 12. Styx Valley, 13. Florentine Valley, 14. Lake Fenton, 15. Great Western Tier, 16. Mount Barrow.

The map is thus intended to show the general range only.

A once wider distribution is indicated by fragmentary skull remains among sub-fossil bone deposits in limestone caves at Flowery Gully. Trapping in the vicinity failed to produce *P. higginsi* and the habitat in the immediate neighbourhood is not consistent with that in which the rat is normally found. There is however, an area of typical rainforest a few miles to the south-west which is a fauna sanctuary where the rat probably still lives today.

HABITAT

The rainforests (see plate 8) which are the preferred habitat of *P. higginsi*, are somewhat variable and their composition is dependent on several factors. Jackson (1965) gives an explanation of these influences and discusses the various ecotonal effects. By far the largest colonies of *P. higginsi* have been found in forests dominated by *Nothofagus cunninghamii* (beech), *Atherosperma moschatum* (sassafrass), *Eucryphia lucida* (leatherwood), *Phyllocladus rhomboidalis* (celerytop pine) and *Anodopetalum biglandulosum* (horizontal scrub), but rainforests dominated by *Eucalyptus* spp. have also been found to support good populations. The under-storey may vary in density and include *Olearia argyrophylla* (musk), *Pittosporum bicolor* (cheesewood), *Drimys lanceolata* (native pepper), *Persoonia gunnii* (Gunns persoonia), *Anopterus glandulosa* (laurel) and *Dicksonia antarctica* (soft tree fern), the latter often being dominant in the gullies.

In many places, particularly in the beech-dominated rainforests, there is a heavy accumulation of decaying debris, fallen timber and rotting stumps and logs, over much of which grows a carpet of wet green moss. Such accumulations produce a labyrinth of sub-surface cavities and the decayed nature of much of the fallen timber and stumps makes additional excavation by the rats a simple matter.

To a lesser degree *P. higginsi* also occurs in the various ecotone habitats bordering the rainforests and on occasions has been trapped in the *Mesomelaena sphaerocephala* (button grass) sedgelands. It is considered that the occurrence in sedgeland is exceptional and that the individuals involved were footloose vagrants on exploratory excursions. Climatic conditions vary greatly. In the sub-alpine areas extensive winter snow falls occur with a covering up to a foot deep lying for several weeks at a time, though the dense canopy and heavy ground litter prevent local isolation. Annual rainfall exceeds 100 inches in much of the western area though in some of the isolated eastern areas it is only half this figure. Temperature likewise varies widely from minima as low as 10°F in the sub-alpine areas to maxima in the middle nineties on the lowlands. However, the sheltered nature of the micro-habitat on the floor of the rainforests no doubt forms an effective buffer to these extremes.

DESCRIPTION

The following description is based on a series of 53 skins and associated skulls and 15 spirit specimens held in the collections of the Queen Victoria Museum. Most have been collected by the author in the vicinity of Waratah, Cradle Mountain, and Corinna in 1963, 1964 and 1965, the remainder being from other places mentioned in the text, or are cage-bred individuals.

External characters

P. higginsi (see plate 9) has a lightly-built, rather delicate and long-legged appearance which is accentuated by its nervous disposition and its habit of making sudden evasive leaps. The ears are comparatively large and prominent, slightly elongated and well rounded terminally. When pressed forward they cover the eyes. The posterior basal region of the ears is well furred but the anterior and posterior surfaces of the terminal half are only sparsely covered with black hairs reaching to 1 mm. The composite effect is greyish-brown somewhat darker terminally but this varies with the angle of viewing.

The face is somewhat pointed with the eyes prominent and set well forward. When the animal is handled and frightened the eyes protrude prominently. The iris is dark brown and the pupil black. The nostrils are naked and pale flesh pink in colour, and the short hairs on the extreme tip of the nose are white. The incisor teeth are slender, the upper set being an orange colour on the anterior surface and reaching to 4 mm. above the gums, the lower set being anteriorly pale yellow and reaching to 6 mm.

The legs are comparatively long and the hind feet large with the claws sharp, well curved and almost white except for a slight pigmentation which is sometimes noticable beneath the semi-transparent surface. The dorsal surface of the feet is well covered with short white hair.

The manus is invariably white, the pads rounded, smooth and prominent. The three interdigitals are about equal in size, the two metacarpals much larger with the outer slightly exceeding the inner. The digital formula is $3 > 4 > 2 > 5 > 1$ the first being reduced and non-functional. There are usually six digital rings beneath the second, third and fourth toes and five beneath the fifth toe.

The pes is pale, the under-surface of the toes being white but a pale greyish tone becomes obvious towards the heel. The pads do not differ greatly in size but the outer metacarpal is always the smallest and is usually rounded in shape. The first and fourth interdigitals usually show a weak division near the outer edge. The digital formula $3 > 4 > 2 > 5 > 1$. The digital rings are irregularly formed in the basal region but generally number eight to nine on the second, third and fourth toe, seven to eight on the fifth toe and four on the first toe.

The tail is longer than the head and body but will easily strip with the result that individuals are sometimes found with reduced tails. The complete tail is slender and finely tapered and is often carried in a posteriorly directed crescent, well clear of the ground (see plate 9). The tail scales are indistinct, of a white colour, and are arranged in about 220 rings which contain up to 20 scales in the basal region but become progressively reduced distally. The tail is sparsely covered with fine bristle-like hairs which are arranged in single concentric circles erupting between the tail rings. The hairs in each ring are evenly-spaced, shortest in the basal region where they reach to about 2 mm, and longest distally where they may reach to 6 mm. They are brown dorsally and white ventrally; the separation being very distinct. Odd individuals may have the entire tail-tip white for a length of up to 15 mm.

There are four nipples situated inguinally as in all pseudomyine rats (see figure 7). The vagina is normally closed. The scrotum becomes more prominent with the approach of the breeding season and may attain a size of 25 by 16 mm. It is well furred except for the posterior end which is nearly naked and in which the skin possesses a slight greyish pigmentation.

Pelage

Sexual dimorphism is not apparent in the pelage. The fur is soft, dense and somewhat fluffy in appearance. It is longest on the rump where it may reach to 25 mm.

in some individuals but is reduced to 15 mm. on the neck and flanks and 10 mm. on the cheeks, mid-head and belly. The guard hairs are inconspicuous and reach to about 10 mm. above the main pile on the back and flanks but on the belly they barely exceed the main pile. They are most numerous on the back where they are a lustrous black for the entire length. On the flanks the tip may be a sandy grey and on the belly, pale grey or white. They taper terminally to a very fine tip.

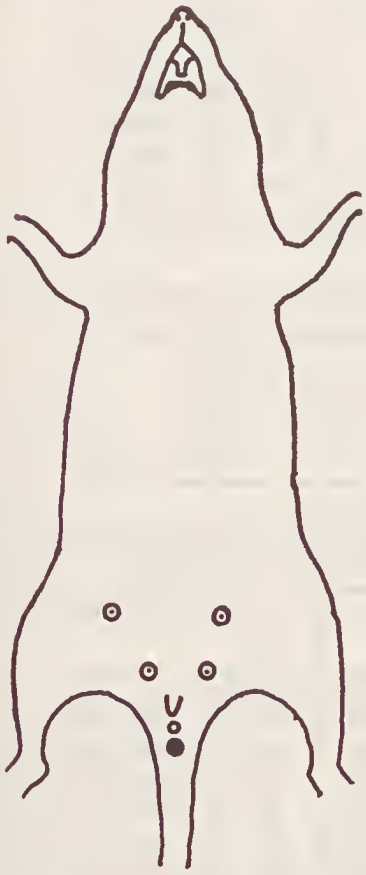

FIGURE 7. Mammary pattern of *P. higginsi*.

The main body pile is a soft leaden grey for the greater part of its length being slightly paler on the belly. The terminal region on the dorsum is a pale sandy yellow, becoming paler on the flanks, and pale grey to white on the ventrum. The composite effect is a greyish brown, being darkest on the back and merging to a pale grey on the belly. The intensity of shading varies with the angle of viewing. The pelage colour on the head and legs is generally similar to that of the body except for the region round the lips where it fades to a pale grey. There is little variation between individual adults but sub-adults in juvenile pelage lack the sandy brown shading and are a more uniform grey.

The mystacial vibrissae are prominent and tapered over their entire length to a very fine tip. They are generally a lustrous black for the greater part of their length but most change terminally to a pale grey or white. A few are white for their entire length, especially the short anterior members. The posterior members are longest and may reach to 65 mm. The anterior members are abruptly shorter and may be as little as 10 mm.

Other vibrissae are not easily discernible but usually there is a single genal reaching to 25 mm., one or two supraorbitals to 35 mm., an interramal to 10 mm. and two ulnacarpals to 10 mm.

Plastic dimensions

Plastic measurements were taken as described in part 2 of this series, and the statistical details given in table 9 are based only on individuals taken in the course of the study and measured by the author. Sub-adults of less than 50 gm. have been excluded.

The heaviest and largest rat collected was a female taken on 27.VI.1963. She had a body weight of 89 gm. and a head and body length of 145 mm. By comparison, the heaviest male recorded was a rat which had been held in captivity for two years. At death, on 27.II.1967, it was found to weigh 82 gm. and to be carrying heavy fat deposits. The heaviest male taken in the wild was collected on 27.VI.1963. It weighed 77 gm. and had a head and body length of 133 mm. This size predominance in favour of females is also illustrated in table 9 which shows that the mean measurements of females slightly exceed those of males in all dimensions except pes length.

The smallest rat collected for processing was a sub-adult female taken on 10.II.1965. It weighed 43 gm. and had a total length of 274 mm. and a head and body length of 113 mm.

The length of the tail, ear and pes when expressed as a percentage of the head and body length (see table 10) gives an indication of the relative proportions of the animals but does not indicate any significant sexual dimorphism.

Skull

The measurements given in table 11 were made on a series of 49 skulls and were taken in the same manner as illustrated in part 2 of this series. Sub-adults of less than 50 gm. have been excluded. Damage resulting from the use of snap traps has reduced the sample size in some instances. The skull of *P. higginsi* (see plates 10 and 11) is finely sculptured and of a rather fragile appearance in comparison to other rats of similar size. The cranium is well rounded and lacks a well defined supraorbital ridge. Table 11 indicates that the skulls of males are slightly longer than those of females though the difference is so small as to be of little significance. The molar teeth are relatively small, the cusps of sub-adults being short but prominent. Molar wear becomes noticable in sub-adults of 50 gm. and increases with the age of the rat. Some adults exhibit extensive molar wear though in no instance was this found to be greatly excessive. The lower incisors are tapered to a fine chisel point, the tapering being evident for almost the entire length of the exposed posterior surface of the teeth. The upper incisors are stout and the posterior tapering is much less acute. No instance of malformation or decay was evident.

HABITS

P. higginsi is primarily a nocturnal rat but odd individuals may occasionally be active in the daytime. Its favoured environment is the forest floor where it makes good use of accumulated debris as cover during its excursions. It is an accomplished climber and in captivity has been observed to run along the underside

of dry dressed hardwood battens supporting the roof lining of its cage. Despite these accomplishments it has not been found to ascend trees, preferring to limit its arboreal activities to running along the logs and branches which form part of the litter, and which may facilitate its movements from point to point.

Observations conducted by the use of a spotlight on both caged and wild rats have shown it to be exceedingly active and inquisitive. When necessary, it can move with great swiftness and if suddenly alarmed will often initiate its escape by an explosive leap of a foot or more in any direction. The long tail is apparently

TABLE 9. Weights (gm.) and measurements (mm.) of *P. higginsi*. Quotations show the number in sample, extremes and the mean in brackets.

	Males	Females
Weight	29: 50 - 82 (65.0)	26: 50 - 89 (68.6)
Total length	23:264 - 326 (300.1)	16:282 - 334 (302.7)
Tail	23:146 - 199 (169.7)	16:160 - 195 (170.8)
Head and body	29:115 - 142 (131.1)	26:120 - 145 (131.7)
Ear	29: 22 - 25 (23.4)	26: 21 - 26 (24.2)
Pes	29: 32 - 36 (33.7)	26: 31 - 35 (33.2)

TABLE 10. Length of tail, ear and pes of *P. higginsi* expressed as a percentage of the head and body length.

	Males	Females
Tail	129.4	129.7
Ear	17.8	18.4
Pes	25.7	26.2

TABLE 11. Comparisons (in mm.) of skulls of males and females of *P. higginsi*. Rats of less than 50 gm. body weight have been excluded.

	26 Males			23 Females		
	No. Sampled	Range	Mean	No. Sampled	Range	Mean
1. Total length	21	31.7 - 36.7	35.0	20	32.4 - 36.4	34.7
2. Condylo-basal length	22	28.5 - 33.3	31.7	21	30.0 - 32.8	31.3
3. Basal length	23	26.2 - 30.7	29.2	22	26.6 - 30.2	28.8
4. Zygomatic width	24	15.5 - 18.2	17.1	18	16.2 - 17.8	16.9
5. Inter-orbital width	26	4.0 - 5.1	4.6	23	4.3 - 5.0	4.6
6. Inter-parietal length	21	4.2 - 5.5	4.9	21	4.5 - 5.6	5.0
7. Inter-parietal width	21	9.5 - 11.5	10.4	21	9.4 - 11.7	10.5
8. Cranium width	23	14.2 - 15.3	14.7	21	14.2 - 15.7	14.8
9. Mastoid width	22	13.7 - 15.0	14.3	18	13.7 - 15.3	14.4
10. Nasal length	25	12.3 - 14.5	13.5	22	12.4 - 14.6	13.2
11. Nasal width	25	3.3 - 4.3	3.6	22	3.3 - 3.9	3.7
12. Palatal length	26	16.1 - 19.4	17.8	22	16.4 - 19.0	17.5
13. Palatal foramen length	26	6.0 - 7.5	6.8	23	6.2 - 7.4	6.7
14. Palatal foramen width	26	1.2 - 2.0	1.6	23	1.5 - 2.2	1.7
15. Width inside M^1-M^1	26	2.3 - 3.1	2.8	23	2.4 - 3.2	2.8
16. Width outside M^1-M^1	26	5.1 - 7.3	6.8	23	6.3 - 7.3	6.8
17. Bulla length	23	4.6 - 5.6	5.2	20	5.0 - 5.5	5.2
18. Length crowns M^1-M^3	26	4.6 - 5.9	5.2	22	5.0 - 5.7	5.4
19. Length alveoli M^1-M^3	26	5.3 - 6.3	5.7	23	5.4 - 6.5	5.9
20. Length crowns M^1-M^2	26	3.6 - 4.2	3.9	23	3.5 - 4.3	4.0

not used in a prehensile manner and is often carried well clear of the ground in a gentle downward curve. This is particularly noticeable when the rat is alarmed. When relaxed it will often sit in a semi-upright position, the forepaws held in a kangaroo-like manner. Under captive conditions it has been found to be dominated by the slower though more aggresive *R. l. velutinus* with which it shares the habitat but avoids contact whenever possible. A faint high-pitched whisper-whistle, almost inaudible to the human ear, can often be heard uttered by caged individuals and it appears to be used as a form of communication. It freely invades human dwellings and at Waldheim in the Cradle Mountain-Lake St. Clair reserve it is a regular nocturnal visitor to the camps and huts situated in the shelter of the forest. Under such circumstances it is a minor pest as it climbs onto tables and feeds on almost any available food items and generally upsets the tourist, who might be disturbed by its presence. If disturbed it will retreat by the way it entered and if circumstances permit will soon return to continue its exploration for food. When so engaged it is usually oblivious to the effects of a spotlight with the aid of which it can be approached and caught by hand. D. King (pers. comm.) has found it nests in wall cavities at Port Davey.

Muddy situations are avoided whenever possible. It has never been known to enter water of its own free will and if forced to do so it swims weakly with the head held well up. Foot beats are rapid and progress slow and it quickly tires. Its natural retreats or nesting places are in holes in the rotting stumps, logs and litter on the forest floor. In many places these sites are heavily overgrown with green moss or covered with an accumulation of fallen leaves. As this rat does not form well defined runways, the entrances to such retreats are often inconspicuous. Though it is capable of gnawing when circumstances necessitate, it gnaws much less frequently than *R. l. velutinus* or *M. fuscus*. Consequently the presence of *P. higginsi* is usually more difficult to detect.

Diet

The natural food of *P. higginsi* is not easily determined. Stomach contents are finely masticated and in every instance have consisted of vegetable matter. This has been found to be variable in colour ranging from green, cream, grey and yellow to brown and black, a feature which indicates a variety of food items. In no instance have insect remains been found in stomach contents but caged rats have been observed to take insects and spiders at every opportunity. Moths of a body length of from 10 mm. to 60 mm. and a wing span of up to 130 mm. have been fed to *P. higginsi* experimentally. These were quickly seized with the mouth, following which they were held clear of the ground with the front feet, with the rat sitting in a semi-upright position. The body parts were eaten for preference, the wings and legs usually being discarded. Large moths were sometimes only partly eaten, the still-living remains being left and consumed later. Squabbling for possession of a single moth was a common occurrence though at times several rats would feed together on a large specimen. Spiders and small lizards were similarly eaten when introduced to the cage. A wide range of vegetable items including green grass and clover clippings, apples, pears, carrots, seeds of various fruits, cabbage and lettuce leaves, commercial animal cubes, and bread have been eaten by caged individuals.

Cage studies have shown that *P. higginsi* drinks liberally when water is available but is capable of living for extended periods without access to free water provided it can obtain succulent food items. Its natural habitat is usually wet for the greater part of the year but extensive areas may lack free water during the dry summer months when it is necessary for the rats within these areas to obtain moisture from other sources.

P. higginsi defaecates and urinates indiscriminately but because it does not produce well defined runways faecal pellets are not easily located. They can usually be distinguished from those of the associated *R. l. velutinus* by their smaller size of 8 to 10 mm. by 4 to 5 mm. in diameter, and in being composed of more finely comminuted vegetable material.

BREEDING

In the wild

The breeding of *P. higginsi* is confined to a summer season. Scrotal development is not obvious outside the breeding season and testes are then carried inguinally. Testes of sub-adult males are usually about 5 x 3 mm. during the winter months and those of adults are about 12 x 5 mm. With the approach of summer and the onset of breeding, testes size increases and may reach as much as 20 x 11 mm. They then descend into the scrotum which also becomes enlarged and conspicuous. Testes contraction and retraction occurs after the breeding season.

Three pregnant females have been collected in the course of the study in the months of November, December and February (see table 12). One lactating female was collected on 24th February. Six females collected in the month of October and one collected on 9th November showed no indications of pregnancy. B. C. Mollison (pers. comm.) observed the birth of a litter of three on 26th November. These data, together with cage studies and the size of sub-adults collected during the autumn and winter, indicate that the birth of young is restricted to the four-month period from mid-November to mid-March, with three being the usual litter, produced in either or both uterine horns.

Nipples are difficult to discern in sub-adults but they become progressively more obvious with lactation and suckling when some fur loss occurs over a radius of 5 mm. from the nipples. When large young are suckling, the nipples in the normal position may be 5 mm. long and 5 mm. diameter at their base, but if distended may reach to a length of 12 mm. At this stage of lactation the tips of the nipples become dark pink, and with care milk can be expressed with the fingers.

TABLE 12. Analysis of three sets of embryos from wild caught *P. higginsi*.

Date	Crown-rump length (mm.)	Number	Uterine Horn		Registered Number
			Left	Right	
24.II.1964	30	4	4	0	1964.1.29
6.XII.1964	6	3	1	2	1964.1.317
13.XI.1965	13	3	0	3	1965.1.254

In captivity

Studies of captives commenced on 6.II.1965 when three males and one female were collected alive near Renison Bell. As they were taken in relatively close proximity to each other it was assumed that one of the males may have been mated with the female. In an attempt to prove this each male was individually introduced into the small cage in which the female was held. The first combination produced an immediate and violent reaction on the part of both animals. Offensive and evasive behaviour was undertaken by both rats as opportunity permitted and initial incompatibility was obvious. A second male produced a similar reaction. When the third male was introduced there was an immediate violent reaction with both rats leaping all over the cage for several seconds. This was followed by a period of quiet as each surveyed the other. They then carefully approached each other and a faint high pitched whisper-whistle was uttered. It is assumed that these two were a mated pair, and after mutual recognition was established the rats nuzzled the fur of each other and huddled close together in the corner of the cage.

The female did not appear to be pregnant or lactating, nor did she show evidence of having bred in that season. The pair were subsequently held in an 10 x 10 x 12 inches cage, as previously described in part 2 of this series, until 15.XI.1965. They were then released into a larger cage measuring 15 feet long by 12 feet wide by 6 feet high which was shared with several *R. l. velutinus* and a pair of sugar gliders *Petaurus breviceps*. Until this time they had shown no indication of breeding though a well-formed domed nest was always maintained and occupied in the corner of the cage.

Subsequent to their release in the larger premises they alternated their diurnally-occupied nests between several sites. These were usually in tin nest boxes measuring 6 x 5 x 5 inches which had been placed at intervals around the walls of the cage and at varying heights from the floor. The nests were formed of straw, shredded into fine fibrous strands by the rats, and packed into the nest boxes so as to form a dense lining, leaving only sufficient room for occupancy. Both rats were invariably found together and they usually blocked the entrance hole from the inside by stuffing it with nesting material. A variety of food items was always available and usually included bread, green vegetables or lawn clippings, commercial dog cubes and occasionally some fruit.

On 11.I.1966 at 0800 hours, the pair were found to be occupying a nest box near the roof of the cage. Upon inspection the male flushed from the nest and young could be heard squeaking. The nest box was removed to a work bench where upon the female flushed and examination revealed three newly born young. The nest was replaced in its original site and the female returned to settle with the young within three minutes. The male was caught and removed from the cage. The following day the nest box, with female and young, was placed in a small breeding cage (previously described) where they were held until 23.II.1966. The female was then removed and liberated in the large cage with the male. The following morning, both adult rats were found occupying the same nest box. About a month later the three young were also released into the large cage and were found to reassociate with their parents and share the same nest. Two of the offspring died in the following six months, probably as a result of fighting with *R. l. velutinus*.

On 13.XII.1966 faint squeaks were heard in an elevated nest box and the original female was found to have produced a litter of two which were then about one day old. Together with her in the nest were the original male and the surviving female offspring of the previous season, then aged about 11 months. All five rats were removed to a small holding cage (previously described) and kept together for the next 18 days. Over this period all continued to thrive and live together without any evidence of animosity. The male and young female played no part in tending the young. On 31.XII.1966, when the juveniles were showing signs of independence, the old male and young female were removed to the large cage leaving the old female with the two offspring of the second litter.

On 29.I.1967, 47 days after the birth of the second litter and 29 days after removal of the male, the old female was found to have produced a litter of four, some time within the previous twelve hours. The two young of the second litter continued to share the maternal nest with their parent and the new offspring, apparently in complete harmony. The parent often nuzzled and licked the young while they were fastened to the nipple and on several occasions the two older young, then about 50 days old, were seen to join their mother in this act as if assisting in the care and attention of the new litter. On the evening of 8.II.1967, when the third litter was 10 days old, the parent was seen to leave them in the nest and to feed and roam about the cage with her two older young. When disturbed by human presence she immediately returned to the nest, sat over the young and activated them to fasten to the nipples, as if to afford protection or to prepare for their removal should danger threaten. (The method of transport is described later).

On a number of occasions, after removal for measuring, the young were carefully handed back to the parent and held about three inches from her nose. On each occasion she readily reached out, seized it in her mouth and immediately placed it beneath her body, often pummelling it excitedly with her paws and nose and turning it on its back as if to hasten its attachment to the nipple. This was usually achieved within a few seconds following which she sat over the young in the manner of a broody hen on her chickens.

The actual birth of young was not witnessed by the author but B. C. Mollison (pers. comm.) observed the birth of a litter from a newly captured *P. higginsi*, the three young being expelled rump first, in a few seconds.

On 22.II.1967 all were transferred to larger quarters together with the old male and the surviving young of the first litter. Two days later the study was disrupted by the loss of six of the rats apparently as a result of abnormally hot weather. Despite the provision of shade and a quantity of dry straw, beneath which the rats formed tunnels, the only survivors were two of the third litter and one of the second. At this date the two youngest were 26 days old and, together, with the other survivor, have since been reared to maturity. The two parents had been held in captivity for just over two years.

DESCRIPTION, GROWTH AND DEVELOPMENT OF YOUNG

The embryo

Three females have been trapped in an obviously pregnant condition and their embryos preserved (see table 12). In registered number 1964.1.317, collected on 6.XII.1964, the embryos were contained within sperical sacs, averaging about 9 mm. in diameter. They were of a crown-rump length of 6 mm. and lacked obvious

detail. The back was strongly arched with the facial region turned under the body, and the legs appearing as mere buds.

In registered number 1965.1.254, collected on 13.XI.1965, the sacs in which the embryos were contained were slightly oval, averaging about 16 x 12 mm. The embryos were of a crown-rump length of 13 mm. and showed considerable detail. The region of the neck was strongly arched with the nose between the hind feet. The eyes were slightly elevated above the surrounding skin and possessed a dark circle of pigmentation. The ears were well formed with the pinnae turned down but free from any adherence to the basal portion. The toes appeared as elongated buds but lacked any evidence of claws. Pads were noticable on the pes and manus. The facial region was well detailed, the mouth being open with the tongue free and prominent. The tail was 8 mm. long, tapering to a fine tip. It was turned ventrally towards the head and reached to the eyes.

In registered number 1964.1.29, collected on 24.II.1964, the embryonic sacs were an oval shape averaging about 30 x 18 mm. The embryos were of a crown-rump length of 30 mm. and though the skin was still pale they were showing a slightly dark subcutaneous pigmentation. The strong arch of the neck region so prominent in the less developed embryos was now greatly reduced and the facial region rested forward of the front feet.

The eyes were still closed and protected by well formed lids. The ear pinnae were turned down for a length of 2 mm. and were adhering to the basal region. The toes were well formed and the claws obvious. The pes measured 6.5 mm. The head was rounded and the nose short. The nostrils were closed but their position was well defined. The mouth radiated 2.5 mm. from the mid-line and there was no evidence of tooth eruption. Colourless mystacial vibrissae had erupted to a length of 1 mm. and supraorbital, genal and interramal vibrissae had erupted to a lesser degree. The tail tapered to 15 mm. and faint scale rings were noticeable to the naked eye. The skin was loose and wrinkled, particularly in the region of the legs, and no body pelage had erupted.

Description of newly born young

P. higginsi has precocious young which are relatively large and have a short natal pelage at birth. Body weight is about 5.7 gm., head and body length 45 mm., tail 23 mm., head 18 mm., ear 4.5 mm., and pes 10 mm.

The eyes are closed with the junction of the lids appearing as a faint crease. The ear pinnae are erect but the apertures appear closed. The nose is short and broad with the mystacial region swollen and prominent. The front and back feet are evenly developed and lack obvious pigmentation. The tail is naked being white on the ventral surface but dark dorsally and only about half the length of the head and body. The skin is loose and wrinkled particularly on the hind legs. It is dark grey dorsally but white and semi-transparent ventrally. The pelage is longest on the dorsum, reaching to 2.5 mm. and of a grey colour. Ventrally it is white and slightly shorter.

A pair of incisor teeth have erupted in both jaws but no molar teeth are visible. The upper incisors are pale yellow on the anterior surface and clear the gums by about 0.5 mm. They are about 0.4 mm. wide, the interspace being about 1 mm. Each is slightly bicuspid and directed prominently inwards towards the throat. The lower pair are white and slightly longer and narrower than the upper, with the interspace being about twice the width of a single tooth. They are chisel pointed and like the upper pair, are set in a pronounced inward direction. This remarkable adaption was also fouud in the new-born young of *M. fuscus* (Calaby and Wimbush, 1964). Soon after birth the young fasten themselves to the inguinally-situated nipples with a tenaceous grip which make their removal by hand a difficult matter without incurring a risk of injury to the young or parent. When the young are so fastened, the parent may suddenly explode from the nest if alarmed and take sudden evasive action in the face of danger, while at the same time transporting the young with her by dragging them along between her hind legs. Rarely do young become accidentally dislodged under such stress and the grip has been found to be sufficiently strong, to permit the young from a few days old, to be carefully lifted until the full weight of the parent and remaining members of the litter are suspended in mid air. Such a grip is undoubtedly aided by the specially adapted incisor teeth. The habit of dragging the young provides a simple means of transport and probably reduces the predation of juveniles. A similar habit has been found to occur in *M. fuscus* (Calaby and Wimbnsh, 1964).

The newly-born young of *P. higginsi* spend much time sleeping in any position but usually upside down beneath the mother while still attached to the nipple. Periodic nervous twitching is eommon and breathing appears deep and forced. They possess good use of their legs and though blind, crawl about with ease. Squeaking noises are uttered when disturbed and are vigorous whenever the young feels pain. When removed from the nipples and held in the hand they nuzzle each other as if attempting to locate a nipple but if not roused will soon settle to sleep.

Growth and development

The following details of growth rate and development were compiled from the three litters of *P. higginsi* reared in captivity. Observations and measurements were made whenever opportunity permitted and were found to be fairly constant, falling closely within a well defined curve (see figures 8 and 9).

At birth the tail is shorter than the head and body length but it grows rapidly to equal the head and body at about 18 days and thereafter to exceed it. The pes also develops rapidly and almost trebles its length in the first five weeks to reach about 30 mm., which is near to that of adults. The rate of growth of the head and body, tail and pes are illustrated in figure 9 and progressive weight gain is shown in figure 8.

There was no significant differenee between the sexes as was found in *R. l. velutinus*. Weaning took place in the fourth week following which development continued unchecked. A gradual decline in the rate of growth and weight gain occurred in the autumn and during the winter months it almost ceased. At this time measurements were near the mean of all the wild eaught *P. higginsi* shown in table 9. An increase in the size and weight of the surviving young of the first litter was found to occur after the wiuter.

AT 8 DAYS (see plate 12) the young are capable of considerable activity and can crawl about the ground with confidenee but if undisturbed appear to spend most of their time asleep. The eyes are closed and the pinna of the ear is free though the aperture is swollen and appears closed. The incisor teeth retain their natal characteristics. The manus is white and the pes has a slight pale leaden hue. The fur on the dorsum is thick and the main pile has erupted at 1 mm. with guard hairs to 4 mm. Ventrally it is shorter and thinner. Mystacial vibrissae reach to 12 mm. The young do not maintain

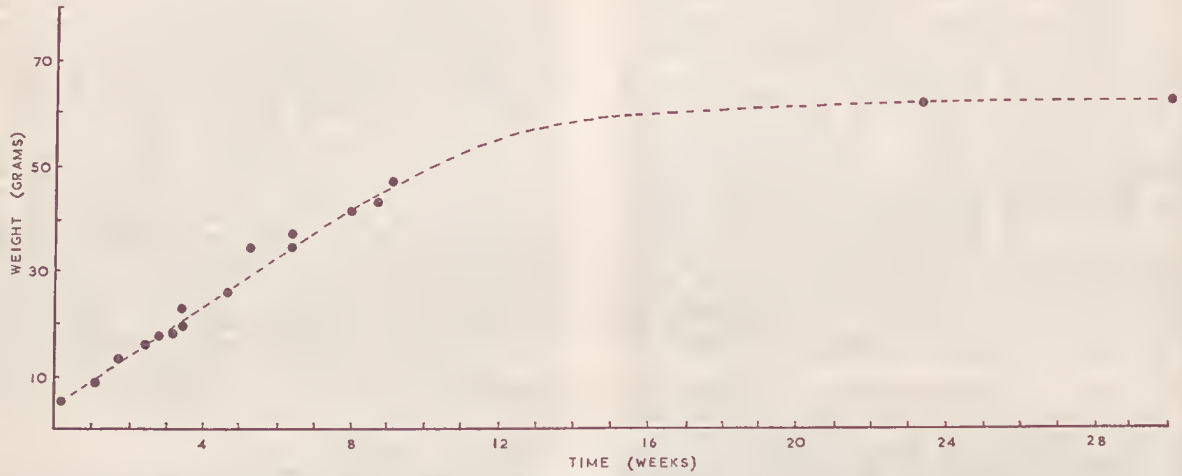

FIGURE 8. Rate of weight gain in the young of *P. higginsi*.

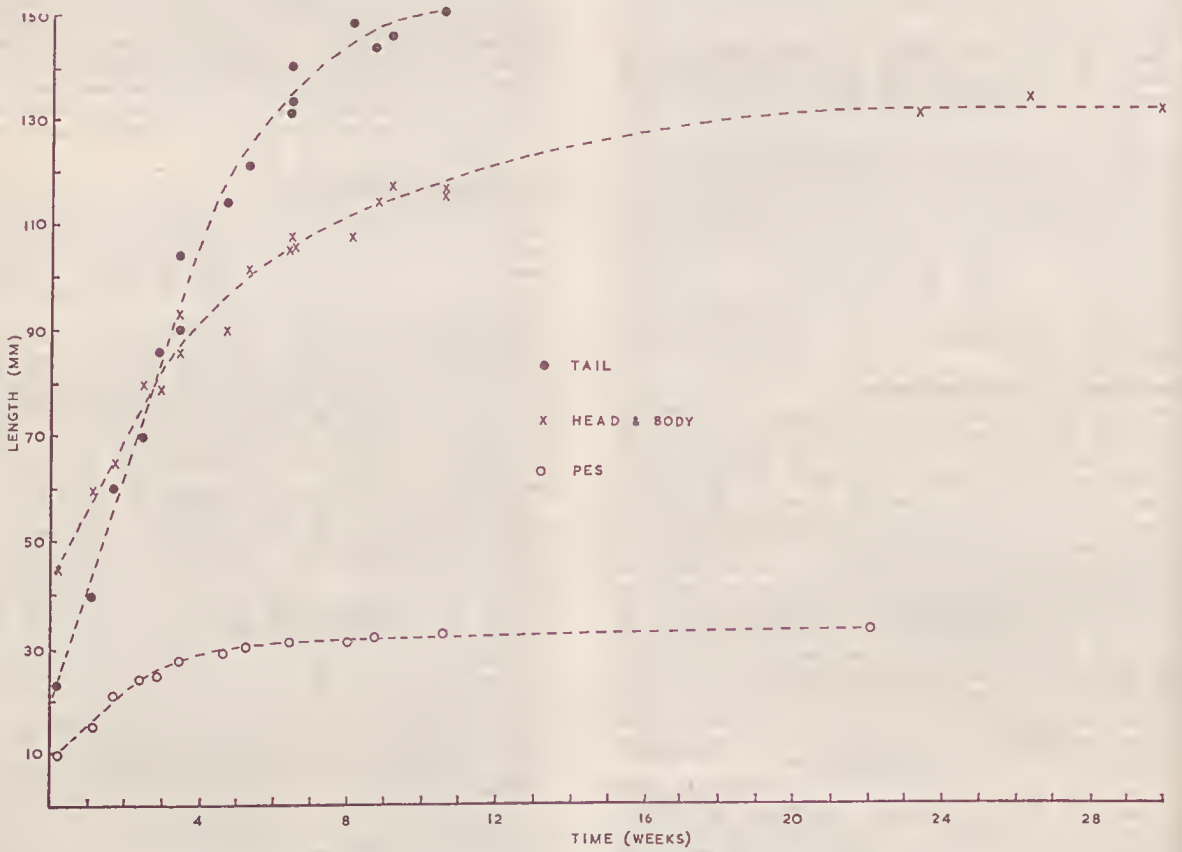

FIGURE 9. Rate of growth in the young of *P. higginsi*.

any suckling order, all nipples being sucked at various times, even if the litter is less than four.

AT 10 DAYS the young, though still blind, take active defensive action if disturbed in the nest when unattended. The slightest touch by the human hand, or any other object which may signify danger, results in a sudden explosion of activity. Lying on their backs the young vigorously beat the air with the feet as if in spiteful defence against anything which may come within reach. Interference with any young and its resultant activity usually triggers the rest of the litter to similar action. For some time afterwards they appear nervous and the return of the parent may momentarily produce such reaction. Recognition is quick and results in the young vigorously seeking and attaching to the nipples.

AT 12 DAYS the eyes are closed. The incisor teeth still retain the natal characters, the upper being erupted to 0.5 mm. and the lower to 1 mm. The main body pile on the dorsum has erupted to 4 mm. with guard hairs to 7 mm. and mystacial vibrissae to 15 mm. Ectoparasites may be present in the pelage.

AT 15 DAYS or thereabouts the eyes open.

AT 18 DAYS the young can run around actively, occasionally calling in a faint whisper-whistle but short sleeps are regularly taken when the opportunity permits. The basal region of the ears has lost its swollen appearance and the ears are functionally active. The incisor teeth retain their natal character and the young still fasten tenaciously to the nipple though at this age their grip is enlarged to include an area of skin and fur surrounding the nipple. If suddenly disturbed when unattached they immediately burrow beneath the parent's belly, turn over on their backs and use their feet to assist in locating the nipple. If the parent is prompted to run with the young attached they endeavour to run with her rather than be dragged as happens at an earlier age. The fur on the dorsum reaches to 6 mm. with guard hairs to 9 mm. Mystacial vibrissae reach to 25 mm. and are white except for the basal region which is dark.

AT 20 DAYS they still attach firmly to the mammary skin of the parent whenever she is in the nest. If alarmed when the parent is absent they are extremely active, often initiating escape action by sudden evasive leaps into the air in the same manner as the adults. The head looks proportionally large and the nose is broad. The dorsal fur reaches to 7 mm. and the guard hairs to 10 mm. Mystacial vibrissae reach to 29 mm. and extend in all directions. Washing is often carried out by the young rats licking the inside edges of the manus and rubbing them rapidly over the facial area.

AT 23 DAYS the young appear less dependent on the parent and are often content to sit beside her unattached. If alarmed they quickly seek a nipple and prepare for escape activity. The parent does not, at this stage, handle the young with her mouth but if one is removed from the nest she shows concern and often will step out to meet it and foster it back into the nest.

AT 25 DAYS (see plate 13) the young show considerable independence and when alarmed will often endeavour to escape by their own endeavours rather than seek the nipple of the parent.

They bite when handled though barely hard enough to puncture the skin of the hand. The incisor teeth have a yellowish anterior surface and are less incurved than at birth. The upper pair reach to 1 mm. and the lower to 4 mm. above the gums. Molar teeth have erupted. The dorsal pelage is a soft slate grey, the sandy yellow terminal band being much less extensive than in the adults. The ventral pelage is a very pale grey. The dorsal fur reaches to 9 mm. with the guard hairs to 15 mm. Mystacial vibrissae reach to 36 mm.

AT 33 DAYS the young are independent of the parent and have become weaned to a solid diet. The tips of the incisor teeth show normal wear and have assumed an adult-like appearance. The dorsal fur reaches to 10 mm. and guard hairs to 18 mm. The mystacial vibrissae reach to 45 mm. A slight dark pigmentation is present in the skin in the posterior scrotal region of males and small nipples can be found on the females.

AT 45 DAYS, except for their smaller size and more slate grey pelage, they are like adults in appearance and habits. The juvenile dorsal pelage remains at 10 mm. and guard hairs at 18 mm. but mystacial vibrissae have increased to 53 mm. The claws are long, well curved and sharp. They are active climbers, timid and alert.

AT 74 DAYS development of the scrotal region of males becomes noticeable, with the skin loose, hair prominent and the dark posterior pigmentation clearly evident.

Juvenile moult

The first moult begins when the young rats are about 50 days old. It starts on the flanks extending from the lower hind legs to the base of the ears and spreads towards the dorsum and ventrum.

AT 60 DAYS it has extended over the back where the new main pile reaches to 2 mm., onto the head and beneath the neck. It is not noticeable on the mid-belly.

AT 64 DAYS the new pelage on the flanks has advanced to 8 mm. but much of the old juvenile pelage still remains. On the mid-dorsal region it reaches to 5 mm.

AT 74 DAYS the new pelage on the flanks has outgrown the old juvenile pelage and reaches to 14 mm. On the mid-dorsum it reaches to 7 mm., and is still hidden by the juvenile pelage. Moult is evident in the region of the nose and lips.

AT 100 DAYS the moult is finished and the sub-adults have assumed an adult pelage.

TRAPPING AND FIELD STUDIES

Trapping

P. higginsi is readily trapped and is attracted by a variety of baits including bread, apple, raisins and a prepared mixture of rolled oats, honey, and peanut butter.

Both the common household snap-trap and Sherman box traps measuring 9 x 3 x 3 inches were used with success. About 10% of rats caught in snap traps suffered some degree of skull damage and about 30% of those taken in the Sherman traps suffered tail damage. *P. higginsi* was the only species in which this tail damage occurred. It resulted because of their relatively greater tail length and high susceptibility to tail slip. The terminal end of the tail was on occasions still outside the trap when the escape door was activated and so it became jammed. *R. l. velutinus, Antechinus swainsonii, Smithopsis leucopus* and *P. breviceps* were also taken in traps set for *P. higginsi,* the last mentioned, in a Sherman trap near Cradle Mountain on one occasion only. Predation on trapped rats was negligible. One

Sherman trap was crushed, apparently by the jaws of a devil *Sarcophilus harrisi* in its attempts to secure the bait or, more likely, a trapped animal. In some localities, particularly near Cradle Mountain, interference from brush possums *Trichosurus vulpecula* often resulted in sprung traps.

The selection of trapping sites was dependent principally upon the available ground cover. Wherever large decaying logs and dead stumps were plentiful or low growing vegetation was dense, traps were set at intervals of 10 to 20 yards. Selected sites were usually beneath some cover or near the entrance to a diurnal retreat if discernable. Success was variable according to the prevalence of animals but usually a 5% catch of *P. higginsi* could be expected. This would be supplemented by an additional 5% of other species. Because of susceptibility of *P. higginsi* to trapping, sets were not normally left more than one night in any area. This daily movement not only enhanced results but also reduced the possibility of local extermination.

Periodic checking of traps at different times of the day and night has indicated that *P. higginsi* is principally nocturnal. Rarely were catches recorded in daylight but they commenced soon after dusk and continued throughout the night. *P. higginsi* was never seen abroad in daylight and captive animals have shown a similar pattern of activity.

Field Studies

The trapping and release of tagged *P. higginsi* commenced near Cradle Mountain on 22.X.1965 in an area of dense myrtle *(Nothofagus)*—dominant rainforest. The floor was heavily littered with decaying logs and other forest debris and other cover was available in the form of low scrub. Forty trap sites were preselected and marked with numbered wooden pegs. They formed two roughly parallel lines about 40 yards apart, the traps being placed at intervals of about 20 yards. Where possible sites chosen were those which suggested the best results. Sherman traps were used and all animals captured were tagged in the posterior edge of the ear with fingerling fish tags. Trapping was carried out whenever opportunity permitted and to 4.VI.1966 eight *P. higginsi* were trapped, tagged and released in five visits. Of these, four were subsequently retrapped and released on five occasions. In addition, the area produced five *R. l. velutinus* on seven occasions, five *A. swainsonii*, none of which were retrapped and one *P. breviceps*, with a pouched young of 10 mm. crown-rump length. Difficulties were encountered, such as heavy winter snowfalls and interference to the traps by other mammals, which adversely effected the results of some visits. Possums were particularly troublesome as they persistently returned and sprung the traps in their endeavours to secure the bait. Results to date are too meagre to indicate any pattern of family groups. The greatest distance between points of tagging and recovery was about 100 yards with a time lapse of 41 days. Two other rats were recaptured over nearly similar distances and time lapse. The smallest rat to be tagged was of 33 gm. taken on 12.II.1966 at an estimated age of six weeks. The longest time lapse between tagging and recovery was 10 months for a male rat tagged outside the study area. It was captured beneath the ranger's house at "Waldheim" near Cradle Mountain on 27.VII.1966, having apparently been attracted there by pollard which had been stored as animal food. It was found freshly dead, as a result of having become jammed among plumbing supplies, at the place of tagging on 28.V.1967.

One female, tagged on 22.X.1965, was subsequently retrapped in a lactating condition on 2.XII.1965. It is intended to continue retrapping in the area as opportunity permits.

MISCELLANEOUS OBSERVATIONS

Keeping in captivity

P. higginsi is easily kept in captivity and despite its alert, nervous nature it has an inoffensive disposition and with a little care and attention can be easily handled. Wild-caught animals are prone to nervous, defensive squabbling if housed in confined quarters and will explode into a flurry of escape activity, leaping and climbing all over the cage at the slightest provocation. This nervousness is instinctive even in cage-bred animals and they may likewise be stimulated to such activity if upset. Newly wild-caught adults will gnaw in an attempt to escape but if provided with suitable housing they quickly settle to the new environment and may be kept in wooden cages without fear of escape by gnawing. A family group comprising several litters may be kept together in confined quarters without difficulty. Recognition of each other is strong and can occur even after a considerable period of separation, permitting immediate sharing of a common nest. Strangers are much slower to adapt themselves to each other's company and usually build separate nests which are occupied for some time before mutual tolerance is achieved.

Caged rats provided with sufficient dry grass or straw readily formed domed nests in the corner of the cage or within the seclusion of a nest box if such was available. Straw is shredded into fine fibrous strands by the rats passing the straw sideways between their teeth, feeding it through with their front feet while their incisor teeth bite in rapid succession. The treated material is then packed in the nest site and the action repeated until a sufficient accumulation has been formed.

Observations conducted with the aid of a spotlight on caged and wild rats has shown that activity is not unduly impeded by the artificial light. *P. higginsi* showed little concern from the presence and stealthy movements of *P. breviceps* but was usually nervous of *R. l. velutinus* and abandoned the feeding place when that species approached.

Diet, as discussed earlier, can include a wide variety of vegetable and invertebrate animal items. Water is taken when available but if absent, survival is possible provided sufficiently succulent food is provided.

Parasites

Ectoparasites have been collected whenever possible and lodged in the National Insect Collection, Canberra. Some recently collected material awaits determination but table 13 gives details of earlier samples together with additional material collected by B. C. Mollison. By far the most conspicuous parasite of *P. higginsi*

PLATE 8. Typical rainforest, the habitat of *P. higginsi*.

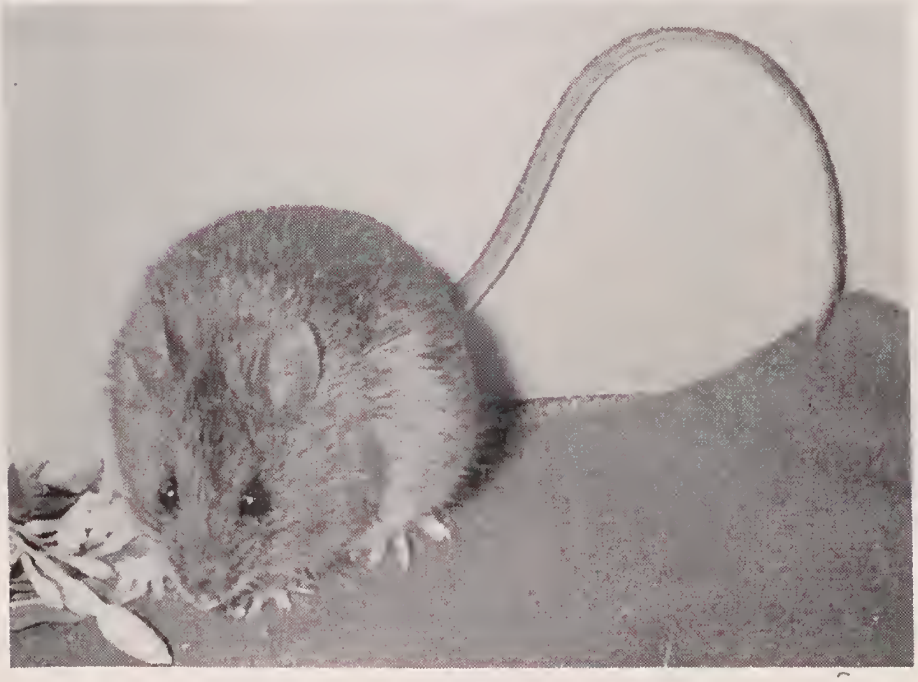

PLATE 9. Adult *P. higginsi*. Photo by H. J. King.

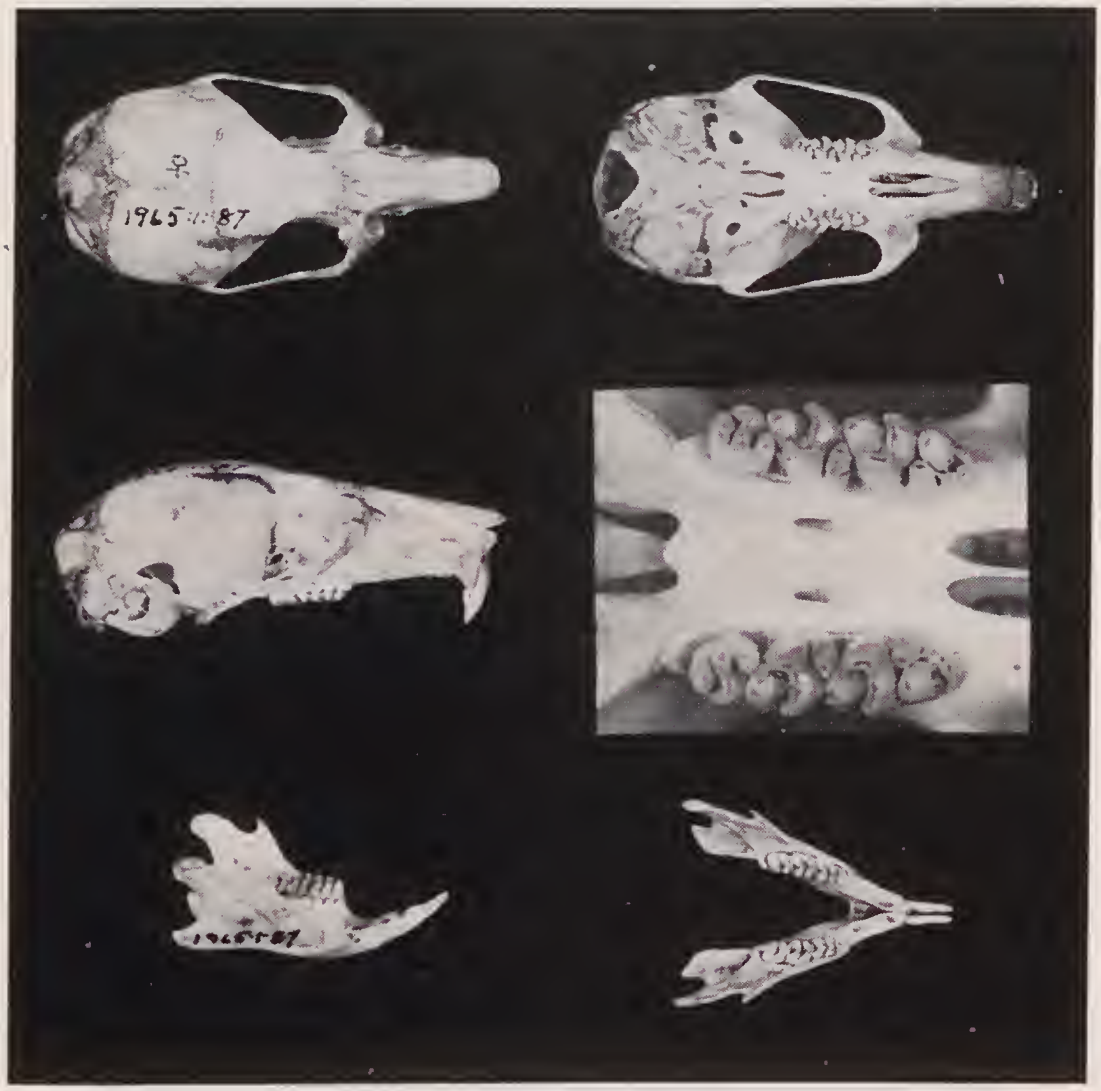

PLATE 10. Skull of a sub-adult *P. higginsi* with the molar teeth enlarged.

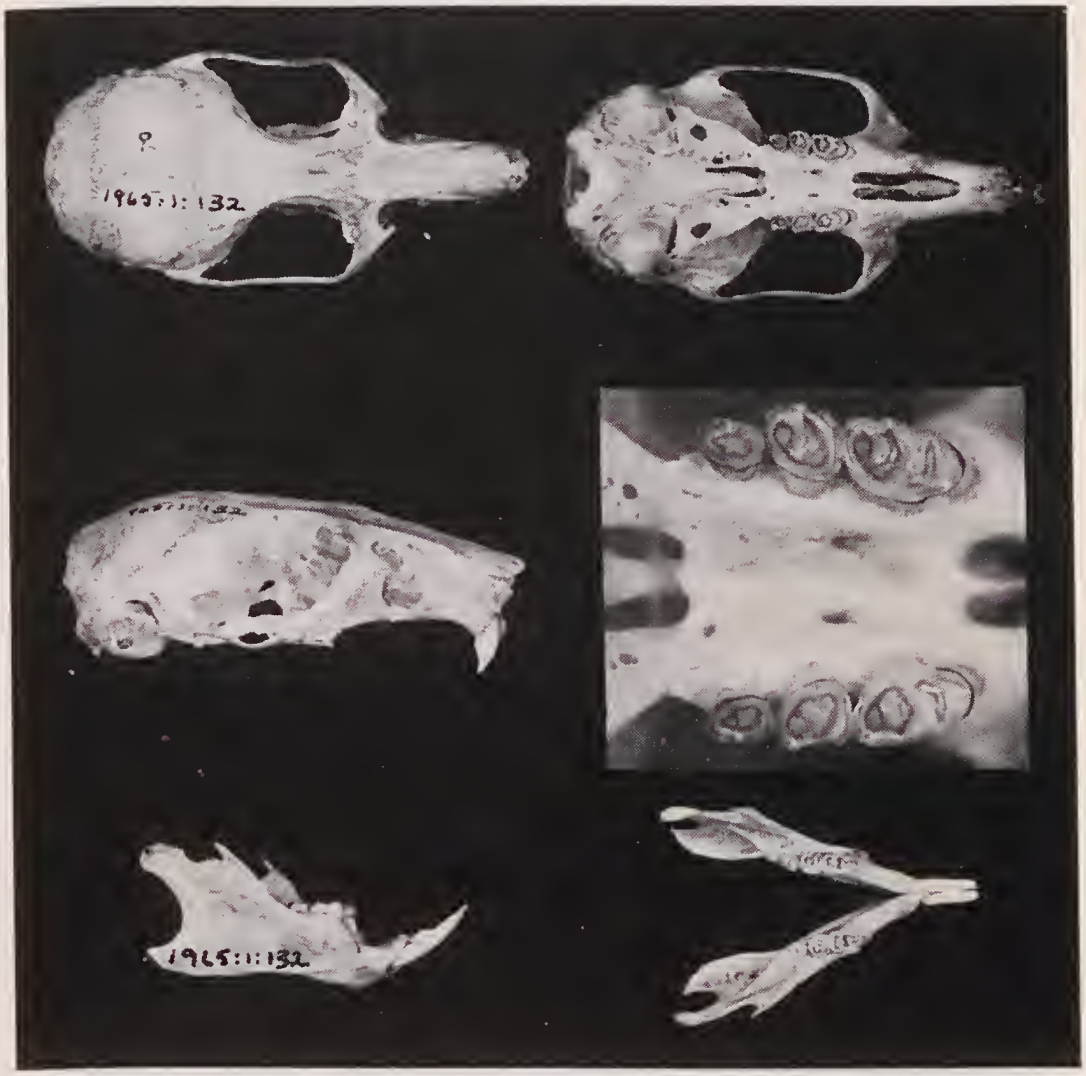

PLATE 11., Skull of an aged *P. higginsi* with the molar teeth enlarged to show the worn cusps.

PLATE 12. Female *P. higginsi* with young at 8 days old attached to the nipples.

PLATE 13. *P. higginsi* at 25 days old.

PLATE 14. View of the eastern shore of Lake Pedder looking northwest. *M. fuscus* occurs in this area. The location of the habitat illustrated in plate 15 is indicated by the cross. Photo by J. W. Thwaites.

PLATE 15. *M. fuscus* habitat on the eastern shore of Lake Pedder (see plate 14). Photo by J. W. Thwaites.

PLATE 16. Adult *M. fuscus*. Photo by H. J. King.

PLATE 17. An adult female *M. fuscus* showing the two pairs of inguinally positioned nipples.

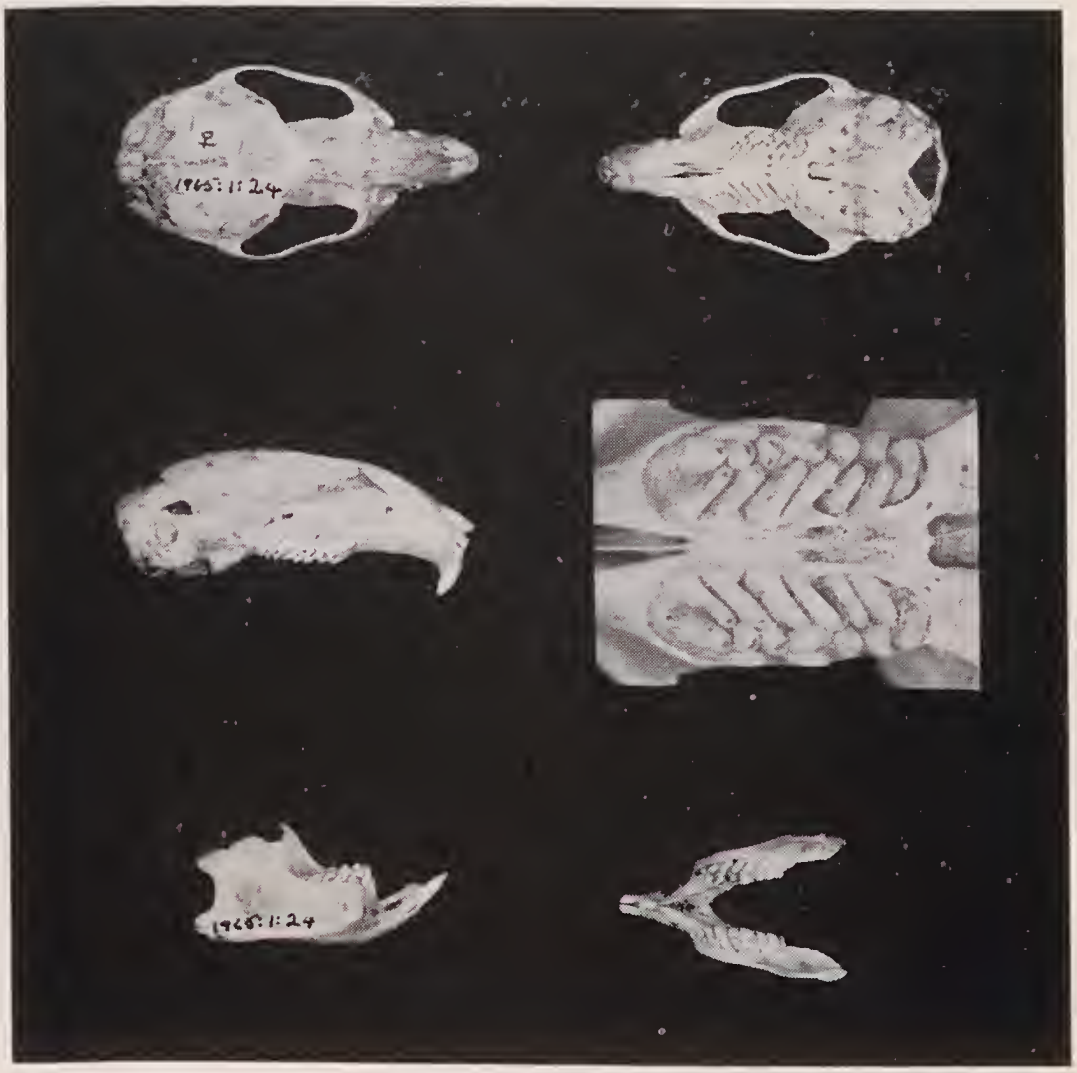

PLATE 18. Skull of sub-adult *M. fuscus* with the molar teeth enlarged to show the long cusps.

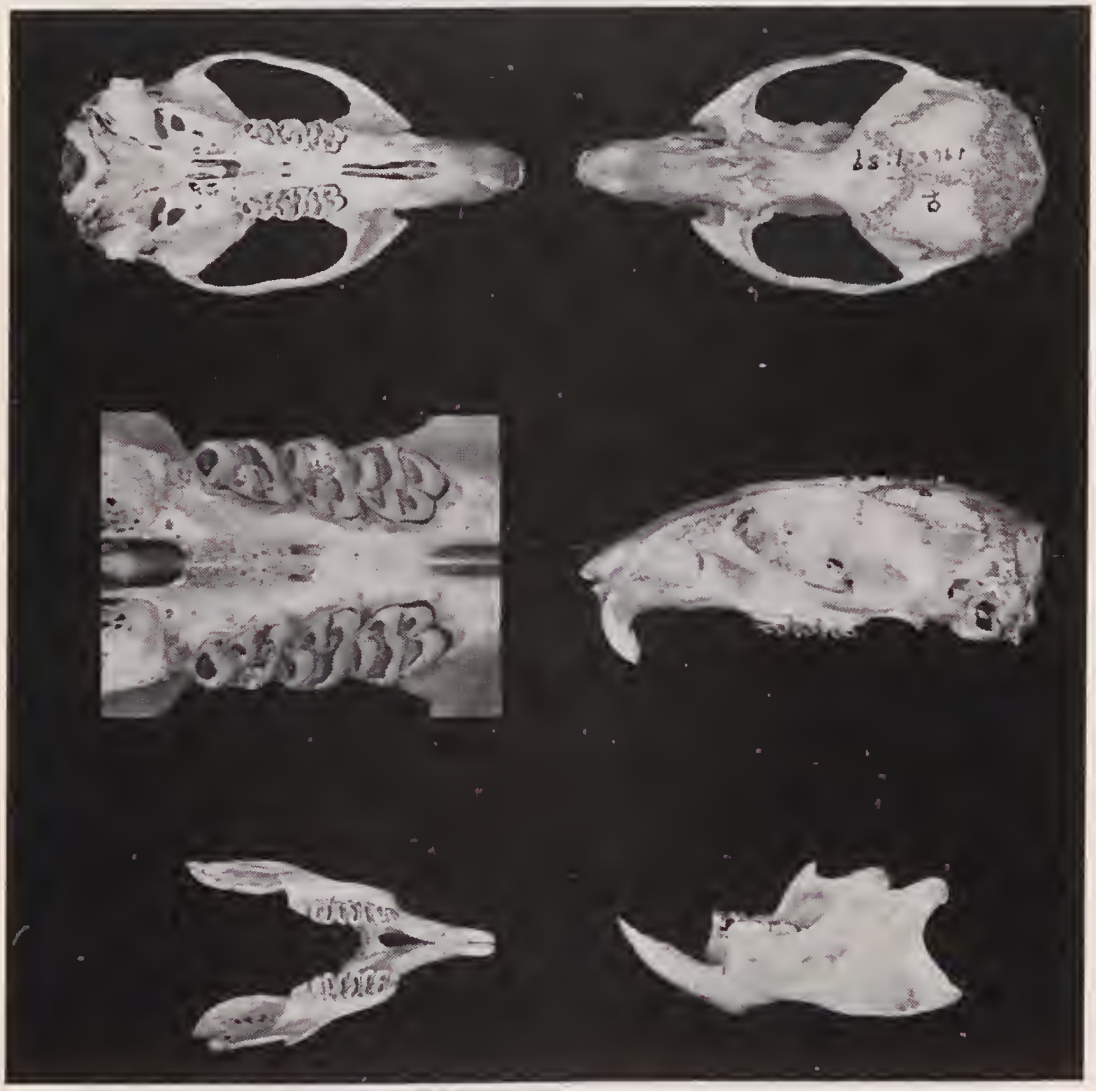

PLATE 19. Skull of an aged *M. fuscus* with the molars enlarged to show the worn cusps.

is the mite, *Laelaps calabyi*. It has been found in the fur on every occasion and occurred on suckling young 12 days old when the main pile of the pelage was 4 mm. long. No obvious skin damage, resulting from heavy tick infestation as was found in *R. l. velutinus*, has been encountered in *P. higginsi*.

The brains of seven *P. higginsi* were sent to the Department of Agriculture for inclusion in a survey of Toxoplasmosis in Tasmania and all produced negative results (Munday 1966). The lungs of three *P. higginsi* were examined by the same authority for *Emmonsia crescens*, also with negative results, but two were found to have small caseous abscesses and subacute interstitial pneumonia. One *P. higginsi* was examined for Leptospires in kidney sections, again with negative results (Munday 1966).

TABLE 13. Ectoparasites collected from *P. higginsi*.

ACARINA

TICKS (determined by Dr. F. H. S. Roberts)

Ixodes tasmani. Waratah, 27.VI.1963.

MITES (determined by Mr. R. Domrow)

Laelaps calabyi Mount Wellington at 4,000 feet; Arve Valley, December 1956; Port Davey, April 1962, September 1962; St. Valentines Peak, 3.VII.1962, Waratah, 7.VI.1963, 27.VI.1963, 30.VI.1963, 24.II.1964, Cradle Mountain, 4.X.1963, 7.X.1963, Renison Bell, 23.II.1964.

INSECTA

FLEAS (determined by Dr. G. M. Dunnet)

Pygiopsylla hoplia. Waratah, 24.II.1964.

Acanthopsylla rothschildi. St. Valentines Peak, 13.VII.1962.

A. sp. Waratah, 24.II.1964.

Stephanocircus pectinipes. Waratah, 7.VI.1963.

LICE (determined by Dr. Theresa Clay)

Hoplopleura calabyi. Waratah, 7.VI.1963, 24.II.1964, Cradle Mountain, 7.X.1963.

Natural enemies

Much of the rainforest in which *P. higginsi* occurs is relatively free of avian and mammalian predators as these animals prefer to hunt in the marginal and less densely forested areas. No doubt the masked owl *Tyto castanops* and quoll *Dasyurus viverrinus* exercise a control in the ecotonal habitat but they normally shun dense rainforest free from roads, tracks and nearby clearings.

Trapping has produced *R. l. velutinus* and *A. swainsonii* wherever *P. higginsi* has been found and it is possible that both these animals exercise some measure of population control on *P. higginsi*. When *R. l. velutinus* and *P. higginsi* adults were experimentally housed together in a confined cage the former was found to have killed and partly eaten the latter on the first night. When housed together in the large cage previously described, *P. higginsi* was always found to evade contact with *R. l. velutinus* whenever possible and the death of two sub-adults and tail damage to the remaining three is indicative of interspecific combat.

A. swainsonii has been found to take mice and small birds (unpub. data) and no doubt would be capable of taking the young of *P. higginsi*. The defensive actions of the unattended juveniles of *P. higginsi*, as described earlier, also suggests some form of predation upon the young. *R. l. velutinus* and *A. swainsonii* are the most likely offenders, though the rarer *S. leucopus* would play a similar role wherever it occurs. The present population of *P. higginsi* in its preferred habitat indicates that predation is not excessive and merely serves to maintain a healthy balance.

Habitat destruction by fire occurs at periodic intervals and to varying degrees but as it has been part of the forest ecology since long before the invasion of European man and is less extensive since the extinction of the aborigines (Jackson 1965) it is not envisaged as a threat to the species. Extensive timber milling is taking place in some localities and this temporarily disrupts or locally annihilates the small mammals. Regrowth is usually rapid and permits repopulation within a reasonable period. As the rain forest extends over a great part of Tasmania, mostly in remote and relatively inaccessible semi-mountainous terrain I see no reason why *P. higginsi* should not continue to flourish within these limits.

Part 4. *Mastacomys fuscus* Thomas

ABSTRACT

The results of three years' (1963-1965) collecting and field observations on the broad-toothed rat *M. fuscus* are recorded.

The known local populations from which specimens have been collected are given and the possible extent of distribution is mapped.

A full description based on 58 specimens collected in Tasmania is given, together with tabulated measurements of plastic features and skulls.

The Victorian sub-species *M. f. brazenori* which was separated from the Tasmanian nominate subspecies on relative tail length is not substantiated on an assessment of the figures provided by this larger series.

Notes are given on habits and the rat's restriction to a very limited habitat type. Diet and the peculiar characteristics of faecal pellets are described.

Breeding has been found to be seasonal, extending from about October to March with two being the usual litter, though more than one litter may be produced annually. Some details are given of embryonic features and their development.

A series of ectoparasites has been collected and some determinations are tabulated.

The influence of natural predation and the effect of future mineral and industrial development and land utilization within the range of its known distribution is discussed.

DISTRIBUTION

Since the inception of this survey in 1963 (see part 1, Introduction) the known range of *M. fuscus* in Tasmania has been extended (see map, fig. 10) to include other areas near Cradle Mountain, Waratah and Lake Pedder. It has now been collected from altitudes ranging from near sea level at Port Davey (see part 1) to about 3,000 feet near Cradle Mountain. Cradle Mountain is within the boundaries of a proclaimed fauna sanctuary from which no specimens may legally be removed. All specimens recorded from there were taken outside the sanctuary boundary.

All populations have been found to be very localized and confined to a limited habitat type. Though they might occur in many places through the area indicated on the distributiou map, the individual occurrences are generally isolated and difficult to locate. Trapping in the north and east of the island has failed to produce *M. fuscus*. The possible distribution range indicated on the map (fig. 10) is based on the few known relict populations and on the extent of range of the preferred habitat in which the rats may be expected to occur. Within this range there are large areas of dense rainforest broken up by wet sedgelands which occur as forest openings (Jackson 1965). It is within the vicinity of the drainage systems of these sedgelands that *M. fuscus* has been found.

The presence of *M. fuscus* material in a deposit of regurgitated pellets of the masked owl *Tyto castanops*, found in a cave near Granton, indicates the presence in recent years of a nearby population as the remains were contemporary with those of introduced rats and starlings (B. C. Mollison pers. comm.).

A once wider distribution is evident from the presence of fragmentary skull remains in bone deposits in the Flowery Gully limestone caves, a series of which is held in the collections of the Queen Victoria Museum.

FIGURE 10.
Localities from which *M. fuscus* has been collected and the possible distributional range based on habitat. Places mentioned in the text are: 1. Cradle Mountain, 2. Waratah, 3. Lake Pedder, 4. Port Davey, 5. Flowery Gully, 6. Granton.

HABITAT

Unlike *Rattus lutreolus*, *M. fuscus* appears to have been unable to adapt itself to a diversified environment and it is now limited to small areas of preferred habitat (Calaby and Wimbush 1964). Collecting in Tasmania has revealed a strong preference for swampy ground which during the winter months may be semi-inundated, though it may dry out in the summer. Its range covers an area of little agricultural or pastoral importance which is periodically subjected to uncontrolled fires. This in turn also limits the area of occupiable habitat as regeneration is slow, and it may take five to ten years before a suitable cover is attained. In Tasmania all the known populations occur in areas of *Mesomelaena sphaerocephala* (button grass) or in various adjacent ecotone habitats. *M. fuscus* invariably occurs in association with *R. l. velutinus* and *Antechinus m. minimus*, all three species sharing the same labyrinth of runways which are formed among the dense vegetation.

Near Cradle Mountain a population survives in an ecotone dominated by *Poa caespitosa* (tussock grass) through which is distributed *Caloraphus lateriflorus* (spreading rope-rush), *Restio australis* (mountain cord-rush) and *Lepidosperma filiforme* (common rapier-sedge) (see part 1, plate 1). This is on steeply sloping ground which for much of the year is waterlogged with drainage from the more elevated areas of myrtle rainforest. Another population was discovered living in an extensive sphagnum moss bog. Burrows were formed in the moss which, at maximum, was several feet in depth. The area was in a small valley and was heavily waterlogged for most of the year. Other populations were found on the banks of small streams where the cover included such additional plants as *Sprengelia incarnata* (swamp heath), *Epacris gunnii* (Gunn's heath), *Baeckea gunniana* (shrubby heath-myrtle), *Monotoca sp.* (broom

heath), *Boronia rhomboidea* (diamond boronia) and *Leptospermum* sp. (tea-tree).

Throughout this sub-alpine habitat the winter climate is severe with air temperatures falling as low as 10°F. Extensive snowfalls annually envelop the area for weeks at a time (see part 2, plate 2) and, though not heavy enough to compress the sheltering vegetation, it does confine *M. fuscus* and associated small mammals to very limited areas by blocking the exposed parts of runways extending across clear ground. Examination of areas under such conditions gives the impression that the rats do not leave the shelter and protection afforded by the snow-covered vegetation, but remain within the confined areas until the thaw permits a return to their normal range. Calaby and Wimbush (1964) found a somewhat similar winter condition in the Whites River area in the Kosciusko State Park, but whereas there the porous nature of the soil renders post-thaw flooding negligible, the reverse is the case in Tasmania and surface water continues to drain away until well after the thaw. Summer temperature may reach as high as 90°F and the mean annual rainfall is about 100 inches.

Finlayson (1933) gives an account of the habitat in which he collected *M. fuscus* at Cradle Mountain. The exact location from which the two Port Davey specimens (Tasmania Museum Reg. ZC 41) were collected is not recorded but except for altitudinal and coastal influences, most of the habitat is basically similar over a great deal of the western part of the island.

In February 1967 the Queen Victoria Museum combined with the Tasmanian Museum to undertake a zoological survey in the vicinity of Lake Pedder. The area under study (see plates 14 and 15) is at an altitude of about 950 feet and the habitat is typical of much of the western highlands. Small mammal trapping, undertaken by J. W. Swift, resulted in the capture of two *M. fuscus* (Reg. Nos. 1967.13 and 16). They were taken in areas about 10 miles apart and separated by a stretch of the Serpentine Valley. This area is heavily waterlogged for the greater part of the year, and only in mid-summer does it dry out to any extent. *R. l. velutinus* and *A. m. minimus* were also collected in the same habitat, as they were in other known *M. fuscus* localities. Lack of time and the nature of the country prevented detailed sampling but the impression gained was that *M. fuscus* occurs extensively though perhaps patchily through the drainage systems of the area.

DESCRIPTION

Descriptions of the pelage and plastic characters of *M. fuscus* based on mainland Australian specimens are given by Brazenor (1936) and Warneke (1960). Thomas (1882) based the original description on a single specimen and Finlayson (1933) amplified this description following the collecting of five specimens near Cradle Mountain. The present description is based on a series of 54 skins and associated skulls and four spirit specimens held in the Queen Victoria Museum. They have been assembled in the course of field studies conducted in the above mentioned areas of the western highlands.

External characters

In general form *M. fuscus* is a stout, thick-set rat (see plate 16) with a strong superficial resemblance to *R. lutreolus* for which it has, on occasions, been temporarily mistaken (Warneke 1960).

The ears are well rounded and appear almost naked but under magnification are found to be clothed on the exposed parts with short, fine sandy-brown hairs which vary in density between individuals. The facial region is more plump and rounded than that of *R. l. velutinus*, the cheeks noticeably more full and the eyes larger and more prominent. The iris is deep brown and the pupils black. The nostrils are naked and a pale flesh pink colour. The incisors are yellow on the anterior surface, the upper set being considerably darker. Both upper and lower incisors wear to chisel points the acuteness of which varies between animals. The lower incisors reach to about 7.5 mm. above the gums on their labial surface which is about twice the overall width of the pair in their mid region. This feature is a useful character in distinguishing live *M. fuscus* from *R. l. velutinus* in which the lower incisors reach to 10 mm. and are exposed for a length of about three times their overall width.

The legs are short and the feet stout with the upper surface sparsely covered with short silvery-grey hairs. A few longer hairs on the extremities of the toes may extend beyond the ends of the claws. The claws are strong, well curved and of a white colour though a faint grey pigmentation is often visible beneath the semi-transparent surface. The under surface of the feet is somewhat variable but the manus is always paler than the pes. The manus is usually a dirty white but may have some pale leaden marking particularly beneath the toes, while the pes is usually a pale leaden-grey over most of its surface. The pads of the feet are smooth and vary slightly in shape between individual rats. In the manus the three interdigitals are approximately equal in size while the two metacarpals are very much larger and more prominent. The digital formula is $3 > 4 > 2 > 5 > 1$, the first being greatly reduced. There are usually four digital rings beneath each toe but in some instances a weakly formed fifth ring is present at the base of the toe.

In the pes the inner metatarsal pad is generally the largest and the outer the smallest with four interdigitals being intermediate. However the inner metatarsal of *M. fuscus* is not as large and is less elongated than that of *R. l. velutinus* though in relative proportions the pes of *M. fuscus* is noticeably longer. This is amply illustrated by Finlayson (1933). The digital formula is $3 > 4 > 2 > 5 > 1$ though the difference between 2, 3 and 4 is very slight. There are usually four digital rings beneath the first toe and five to six beneath the other four which is in excess of the number found in *R. l. velutinus*.

The tail is shorter than the head and body, stout and gently tapered with leaden-grey scales arranged in about 120 irregular rings. Near the base of the tail the scales number about 20 each ring but near the tip they decrease to about ten. The tail is sparsely covered with bristle-like hairs which are generally a dark grey colour though some, particularly the shorter ones and those on the ventral surface, may lack pigmentation. In the mid-region of the tail they are arranged in groups of three, erupt from behind each scale and are directed anteriorly. On the distal portion they become reduced in numbers but near the base they may increase to 6 in a group. They vary greatly in length but may reach to 3 mm., more than double those of *R. l. velutinus*, a feature which gives them a softer appearance.

The nipples number four and are situated inguinally, as in all pseudomyine rats. (See plate 17). The scrotum becomes prominent with maturity and the approach of the breeding season when it may measure up to 40 x 25 mm. and contain testes of 25 x 15 mm. It is well furred except for the posterior region which is naked and darkly pigmented.

Pelage

No sexual dimorphism is noticeable in the pelage. The fur is soft, slightly more so than in *R. l. velutinus*,

dense, and in fully-furred rats reaches to 20 mm. over the dorsal region, reducing to 10 mm. on the head and ventral region. The guard hairs are prominent on the dorsum, are black for their entire length and well tapered. They are longest on the rump where they may reach to 30 mm. On the ventrum they are nearly similar to the main pile.

The body pile is a soft leaden-grey being slightly paler on the ventral surface. The terminal region is a sandy-yellow on the dorsum, in some instances with the extreme tip black. On the ventrum this terminal region merges to a very pale grey. The overall composite effect varies slightly between individual rats and is dependent on the prevalence of the guard hairs. In some instances these are hardly noticeable and these rats have a slightly more sandy appearance. As mentioned by Finlayson (1933), the composite effect varies with the angle of viewing.

Plastic dimensions

Plastic measurements were taken as described for *R. l. velutinus* (see part 2). Table 14 is based on a series of 37 rats comprising 20 males and 17 females. All rats of a body weight of less than 100 gm. have been excluded.

The heaviest rat collected was a male taken in the month of June which had a body weight of 196 gm. and a total length of 305 mm. with a head and body length of 195 mm. By comparison the heaviest female was taken in February and in heavy lactation. She weighed 158 gm., was 299 mm. in total length, and had a head and body length of 170 mm. The heaviest pregnant female was also taken in February and weighed 150 gm. She carried two embryos developed to 35 mm. crown rump length. This is considerably less than that recorded by Calaby and Wimbush (1964) for a captive rat which attained a body weight of 173 gm. prior to parturition. The lightest male was collected on 11.II.1965 and was a sub-adult of 53 gms. The lightest female was collected on 21.II.1965 and was a sub-adult of 45 gms.

The length of the tail, ear and pes when expressed as a percentage of the head and body length (see table 15) gives an indication of the relative proportions of animals but indicates no significant sexual dimorphism.

Ride (1956) using dimensions provided by Brazenor, separates the Victorian form as *M. f. brazenori* from the nominate Tasmanian form on the relative lengths of the tails when expressed as a percentage of the head and body length. Ride submits that the tails of *M. f. brazenori* average 73% while those of *M. f. fuscus* average 64% for animals of similar general size. Calaby and Wimbush (1964) found all other modern mainland Australian *Mastacomys* material inseparable from Ride's *M. f. brazenori*. They list a small series from Loch Valley (measured by Warneke) in which the tail averages 74% and a series of six near adults from near White's River in which the tail averages 71.3% of the head and body length (range 68.2—75%). The distinction between *M. f. fuscus* and *M. f. brazenori* based on the relative tail length is not supported by my examination of the nominate sub-species as the figures given in table 10 fall within the range of those given by others for the mainland Australian form. This discrepancy in results obtained by different authors is probably due to different methods of measuring the tail.

Skull

The measurements given in table 16 were made on a series of 36 skulls and were taken in the same manner as illustrated in part 2. Skulls of rats of a body weight of less than 100 gm. have been excluded. Because of skull damage caused by trapping it was not possible to measure every feature in each instance and accordingly the number on which measurements were made is recorded for each feature. No sexual dimorphism is indicated in skull proportions.

Tooth wear varies greatly within the series. Sub-adults at about 50 gm. exhibit very little wear, the molar cusps being long and well defined. (See plate 18). Those of the upper set are strongly arched posteriorly particularly in the anterior member in which the angle is about 45 degrees. Those of the lower set are sloped anteriorly with the posterior member bearing the more prominent slope. Some rats with a body weight in excess of 100 gm. had very little molar wear, while in others molar wear was advanced (see plate 19) though in no instance was it found to be excessive. Annual grouping based on the degree of molar wear as illustrated in *R. l. velutinus* (see part 2, plate 5) was not possible and such wear appears to be slower and less pronounced in *M. fuscus*. This, in turn, suggests a somewhat longer life span.

Lower incisors are usually tapered by wear on the posterior surface to a fine chisel-like cutting edge, though in one instance they were found to be strongly notched apparently as a result of abnormal contact with the upper set. Except for this, no case of malformation or decay was evident.

A detailed description of the skull is given by Finlayson (1933).

HABITS

Runways

M. fuscus has been found principally in wet, swampy areas. Its occurrence is usually associated with well worn runways as described for *R. l. velutinus* (see part 2 of this series) but as no habitats are known in which *R. l. velutinus* is not also present, it is difficult to say what part *M. fuscus* plays in the formation and maintenance of runways. The runways in known *M. fuscus* habitat are identical to those in areas where only *R. l. velutinus* occurs but as both animals are so nearly similar in size and habits this is to be expected and it can fairly be assumed that both species are responsible for their formation. *M. fuscus* has been trapped on well-used runways which are virtually under water or on which the surface has become muddy by the action of the rats' feet. It appears to favour such conditions preferring them to those of the better drained areas of somewhat similar vegetational cover in the same vicinity. It does not vacate its established range when this dries out during the summer months.

No known nests of *M. fuscus* have been found but it is assumed that they are placed in the dense clumps of button grass or tussock grass in the same manner as those of *R. l. velutinus* (see part 2). It has never been found in subterranean burrows and its preferred habitat is quite unsuitable for burrowing.

M. fuscus is diurnally active and a sub-adult was seen feeding in an exposed situation about mid-day. Numerous individuals have been trapped during the hours of daylight.

Feeding and faeces

Though *M. fuscus* has been found to take a variety of foods in captivity (see later), its normal diet in a wild state appears to be purely vegetarian and of a very limited range. The stomach contents generally appear of an even greenish mealy nature and only in one instance was it found otherwise. This was in an animal taken at Lake Pedder in mid-February, in which the stomach contents were of a reddish-brown colour. A microscopic examination of stomach

TABLE 14. Weight (gm.) and measurements (mm.) of 37 *M. fuscus* with a body weight of 100 gm. or more. Quotations are for extremes with the mean shown in brackets.

	20 Males	17 Females
Weight	100 - 196 (136.2)	106 - 158 (134.2)
Total length	255 - 310 (278.5)	261 - 299 (279.8)
Tail	102 - 135 (115.2)	109 - 129 (117.4)
Head and body	147 - 195 (162.8)	147 - 182 (163.1)
Ear	20 - 23 (21.4)	20 - 22 (20.9)
Pes	31 - 35 (32.8)	31 - 35 (32.5)

TABLE 15. Length of tail, ear and pes of 37 *M. fuscus* of a body weight of 100 gm. or more expressed as a percentage of the head and body length.

	20 Males	17 Females
Tail	70.8	72.0
Ear	13.2	12.8
Pes	20.1	19.9

TABLE 16. Comparisons (in mm.) of skull measurements of males and females of *M. fuscus* with a body weight of 100 gm. or more.

	17 Males			19 Females		
	No. Sampled	Range	Mean	No. Sampled	Range	Mean
1. Total length	13	38.1 - 44.2	40.5	16	37.4 - 42.5	40.2
2. Condylo-basal length	13	35.5 - 41.9	38.3	17	36.6 - 39.8	37.9
3. Basal length	13	32.9 - 39.0	35.6	17	32.6 - 37.2	35.0
4. Zygomatic width	13	21.2 - 23.4	22.1	14	20.7 - 23.1	22.2
5. Inter-orbital width	14	3.6 - 4.2	3.9	18	3.6 - 4.3	3.9
6. Inter-parietal length	14	4.7 - 6.9	5.8	16	4.5 - 5.9	5.4
7. Inter-parietal width	14	9.3 - 11.0	10.2	16	9.7 - 12.0	10.7
8. Cranium width	14	15.9 - 17.5	16.9	16	16.4 - 17.8	17.2
9. Mastoid width	13	15.9 - 17.8	16.8	16	15.4 - 17.5	16.7
10. Nasal length	17	14.1 - 16.7	15.7	18	14.5 - 17.1	16.0
11. Nasal width	17	4.0 - 4.9	4.4	19	4.2 - 4.8	4.4
12. Palatal length	15	20.3 - 25.9	22.8	19	21.3 - 24.2	22.7
13. Palatal foramen length	16	6.7 - 9.7	7.6	19	7.2 - 8.3	7.7
14. Palatal foramen width	15	1.4 - 2.0	1.7	19	1.3 - 2.2	1.6
15. Width inside M^1-M^1	15	1.3 - 2.2	1.8	19	1.4 - 2.4	1.9
16. Width outside M^1-M^1	13	8.5 - 9.4	8.8	19	8.5 - 9.5	9.0
17. Bulla length	17	5.1 - 6.3	5.7	17	5.7 - 6.7	6.1
18. Length crowns M^1-M^3	17	7.3 - 9.0	8.2	19	8.0 - 9.3	8.5
19. Length alveoli M^1-M^3	17	9.2 - 10.9	9.9	19	8.8 - 10.5	9.7
20. Length crowns M^1-M^2	17	4.9 - 6.0	5.3	19	4.7 - 5.8	5.4

contents of several animals revealed the contents to be finely comminuted and to consist mainly of common rapier-sedge with the addition of a small quantity of leafy tissue from a small-leafed dicotyledon, and fragments of a very finely-stemmed grass. Fragments of sphagnum moss have been found in stomachs and teeth but is not believed to be a favoured food. There was a complete absence of insect fragments in the sample microscopically examined, and all other samples examined with the naked eye have failed to suggest anything but a purely vegetarian diet.

The sap of rapier-sedge is rich in green pigmentation and if chewed, readily produces a bright green juice. This colouration is prominent in the faeces of *M. fuscus* and serves to distinguish it from *R. l. velutinus* which produces faecal pellets of a brown or greyish colour. The faeces of the latter species are also drier and less finely comminuted. *M. fuscus* defaecates and urinates indiscriminately and its presence can often be predicted by a scattering of the characteristically soft green faecal pellets along the runways.

BREEDING

In the wild

The testes of sub-adult males are not descended during the rats' first summer and even in sub-adult animals up to 90 gm. in weight collected in February no scrotal development had taken place and the testes measured about 7 mm. by 4 mm. In the following spring, with the approach of the breeding season, the scrotum develops to about 40 mm. by 25 mm., the testes enlarge to about 25 mm. by 15 mm. and are then carried low in the scrotum.

Seven females have been trapped in a pregnant condition (see table 17), the earliest seasonal record being for a rat in early pregnancy taken on 5.X.1963

TABLE 17. Analysis of seven sets of embryos from wild caught *M. fuscus*. Those marked with * were too premature to measure.

Date	Crown-rump length (mm.)	Number	Uterine horn	
			Left	Right
5.X.1963	*	2	1	1
5.X.1963	*	2	Not	recorded
6.X.1963	*	2	2	0
9.II.1965	28	2	1	1
11.II.1965	33	2	2	0
20.II.1965	14	2	2	0
21.II.1965	75	2	1	1

and the latest on 20.II.1965 with two embryos of 17 mm. crown-rump length carried in the left horn of the uterus. Her nipple condition indicated recent lactation and the right uterine horn possessed three prominent placental scars. All of the pregnant females were carrying two embryos, though Calaby and Wimbush (1964) record litters of one, two and three. The evidence shows that the breeding season is in summer and extends from October to March, with each female producing more than one litter annually. Calaby and Wimbush (1964) record three litters from a captive animal over the period December 21 to March 10.

In captivity

Attempts to breed *M. fuscus* in 1964-5, in small cages as described in part 2, failed. Because of loss of the breeding stock no attempts were made under the more roomy conditions which were found to produce the spectacular breeding success in *R. l. velutinus*. Breeding in captivity has been successfully achieved by the C.S.I.R.O. Division of Wildlife Research and some results are given by Calaby and Wimbush (1964).

Description of embryos

At a crown-rump length of 7 mm. the embryo is contained within an approximately spherical sac about 12 mm. in diameter. It lacks obvious detail except for the eye which appears as a tiny circle of dark pigment. The tail reaches to about 4 mm. and is finely tapered; the fore and hind limbs are mere buds of about equal proportions and the head and neck region is almost half of the total body mass. The neck is strongly arched to such extent that the facial region is almost between the hind feet and is overlaid by the tail.

At a crown-rump of 14 mm. the embryo is contained within a sac about 17 mm. in diameter. The eye appears as a darkly pigmented ring, the ears and facial features are obvious, the mouth is well formed and can be easily opened and the tongue is prominent and free moving. The tail reaches to 5 mm., the feet are prominent and the toes well splayed. The neck is less arched and the chin rests between the front feet with the tail just reaching the nose. The head and neck region are almost half the total body mass.

At a crown-rump length of 28 mm. the sac has developed an elongated appearance, reaching to 30 mm. long and 15 mm. in diameter. The eyes no longer appear as dark rings, the lids being obvious and about 2 mm. wide. The facial features are prominent and the posterior members of the mystacial vibrissae have erupted to about 1 mm. Wrinkling occurs in the skin, the tail tapers to 11 mm., the feet are well formed with the pads obvious and the vagina and anus appear to be open. The head is about 35 per cent of the total body mass, the nose carried down at right angles to the body where it rests forward of the front feet.

At a crown-rump length of 33 mm. the embryo closely resembles that of the 28 mm. embryo. The tail tapers to 12 mm. and the pes is 7.5 mm. The ear pinna is free but folded down over the ear opening. Except for the mystacial vibrissae there is no evidence of pelage eruption or of the presence of teeth.

Calaby and Wimbush (1964) give the following measurements of a new born young: head and body 63 mm., tail 24 mm., hind foot 13.4 mm., and the ear 5 mm. They also give measurements of a litter of slightly lesser proportions. They describe the pelage as developed to 4 mm. in the mid dorsal region, mystacial vibrissae up to 8 mm. and the presence of

two pairs of colourless incisor teeth which project about ½ mm. They also give an account of growth and development of young in captivity and describe the adaptation of the incisor teeth which enables the young to maintain a grip of the teat while being dragged around by the parent. This adaptation is apparently similar to that occurring in the endemic Tasmanian pseudo-rat *P. higginsi* (see part 3).

TRAPPING AND FIELD STUDIES

Trapping

The study of *M. fuscus* has been undertaken in conjunction with that of *R. l. velutinus* and the same methods, equipment and decoy baits, as described in part 2, have been used for both species. The apparently limited vegetarian diet of *M. fuscus* makes it a more difficult rat to trap as there appears to be little attraction to all of the baits used to date. Trapping with Sherman traps in known *M. fuscus* populations has resulted in negative catches where a subsequent trapping in the same area with snap traps has produced good results. Many of such catches have been made as a result of the rat running across the trap and not by its taking the bait. Consequently, rats have on occasions been caught by the foot or tail. Almost all catches were made on well-defined runways with the trap set in such a position that the rat runs into it during its normal progression. Trap checking at various times of the day has shown *M. fuscus* to be diurnally active, with dusk visits often producing the best results. Trapping in any one area was normally limited to a 24 hour period not only to enhance the catch but also to safeguard against local extermination.

Field Studies

A field study of a tagged population was commenced near Cradle Mountain on 22.X.1965. The area selected was vegetated principally with poa tussock-grass and was on a steeply sloping bank. Previous examination had confirmed the presence of a considerable *M. fuscus* population. Trapping was carried out in a rectangular grid pattern with 40 Sherman traps dispersed over an area of about 150 yards by 75 yards, and a variety of baits were tried. On the initial set the only animals caught were three adult *M. fuscus*. They were tagged with fingerling fish tags, weighed, and various other details recorded before release. On 4.XII.1965 two additional *M. fuscus* were trapped and similarly tagged. From the commencement of the field study to 17.X.1966, seven trapping excursions were made to the area but no *M. fuscus* was ever recaptured, though the presence of the species was obvious from the condition of faecal pellets on the runways. Three additional small mammal species were also trapped in the study area over this period. Thirteen *R. l. velutinus* were taken on 55 occasions, 10 *A. swainsonii* on 15 occasions and 3 *A. minimus* on 3 occasions. The failure of the *M. fuscus* study is believed to be a direct result of their selective feeding habits and their consequent reluctance to enter the Sherman traps as the baits offered were not sufficiently attractive.

Occasional bait sampling or curiosity apparently accounts for an odd catch but successful live trapping seems dependent on the use of a run-through trap or one activated by the animal passing along its runway as no known bait offers a sufficient lure to entice *M. fuscus* into box type traps in satisfactory numbers.

MISCELLANEOUS OBSERVATIONS

Keeping in captivity

M. fuscus has a docile nature, particularly the males. Wild-caught animals will quickly become accustomed to handling and show little fear of humans. When the individuals which were tagged and handled in the study area were released they moved slowly away without haste or obvious fear. One climbed across an observer's boot and smelt around the vicinity of the equipment for about half a minute before moving away along a runway. Individuals retained for cage studies took food items from the hand when these were presented through the wire of the cage, within a few minutes of capture. Animals kept and hand-fed in small cages soon became so quiet that when they were released in an enclosed room they were recaptured with no difficulty. One such male was released for several minutes in natural bush where it disappeared beneath the thick vegetation. On reappearance it was again picked up without difficulty. It will feed on a variety of vegetable foods when no alternative is available, but apple, bread, lawn clippings, and commercial dog cubes have formed the main diet of caged individuals. Water is taken liberally if available but experiments and field observations have shown that *M. fuscus*, like *R. l. velutinus* (see part 2), is capable of surviving over dry periods without free water, provided it can obtain reasonably succulent food.

Parasites

Ectoparasites have been collected from *M. fuscus* whenever possible and lodged with the National Insect Collection, Canberra. Some determinations are given in table 18 together with an earlier sample from Port Davey. No abnormally heavy infestations of ectoparasites or obvious endoparasites have been noted.

Lice taken from *M. fuscus* which were collected at Mt. Kate, near Cradle Mountain on 6.X.1963, have been described by Kuhn and Ludwig (1966) as a new species, *Hoplopleura mastacomydis*. This louse has also been collected from *M. fuscus* in New South Wales.

TABLE 18. Ectoparasites collected from *M. fuscus*.

ACARINA
TICKS (determined by Dr. F. H. S. Roberts)
Ixodes tasmani. Cradle Mt., 5.X.1963 (nymph), 8.XII.1963 (nymph).
MITES (determined by Mr. R. Domrow)
Laelaps cybiala. Port Davey, 1951; Cradle Mt., 26.IV.1963, 5-7.VI.1963, 4-6.X.1963, 8.XII.1963.
INSECTA
FLEAS (determined by Dr. G. M. Dunnet)
Pygiopsylla hoplia, Cradle Mt., 26.IV.1963, 5-6.X.1963.
Macropsylla hercules. Waratah, 6.VI.1963.
LICE (determined by Dr. Hans-Jürg Kuhn)
Hoplopleura mastacomydis. Mt. Kate (near Cradle Mt.) 6.X.1963; Cradle Mt. 26.IV.1963.

The brains and lungs of one *M. fuscus* were sent to the Department of Agriculture for inclusion in a survey of the occurrence in Tasmania of Toxoplasmosis and *Emmonsia crescens*. The results were negative (Munday 1966).

Natural enemies

No evidence has been found to suggest excessive predator pressure on *M. fuscus*. Its normally close association with *R. l. velutinus* no doubt renders it liable to predation suffered by that species which in the past appears to have assisted in the maintenance of a healthy balance (see part 2). The Quoll *D.*

viverrinus, is not uncommon over much of the range of *M. fuscus* and no doubt it takes this rat, along with other small mammals. Extensive Quoll padding which was found following an overnight snowfall on an area of known *M. fuscus* occurrence near Cradle Mountain (see part 2) is indicative of Quoll predation. The finding in the area of the broken remains of a skull and limb bones of *M. fuscus* was consistent with what may be expected from Quolls.

The marsupial mouse *A. m. minimus* invariably occurs in the same habitat and in association with *M. fuscus*, and *A. s. swainsonii* may similarly be encountered in ecotone areas bordering rain forest. Both these ravenous little carnivores may be expected to take young rats if the opportunity offers. The feral cat is uncommon in *M. fuscus* habitat. The greatest factor limiting the population of *M. fuscus* appears to be the availability of suitable habitat. Though there are many suitably swampy drainage areas in the western half of Tasmania, much is uninhabitable because post-burn regrowth is not sufficiently advanced to provide good cover. Fire has always been a factor in the maintenance of the open sedgelands (Jackson 1965) but at the same time such fires often remove areas of habitat on which *M. fuscus* depends for survival.

Summer cattle grazing also destroys some habitat. During this normally dry season cattle congregate around the watering places and greener areas and often these are also the habitat of *M. fuscus*. Consequently the severe trampling in cattle camps, together with the grazing, renders such areas unsuitable for *M. fuscus*.

Though the range of *M. fuscus* is included in an extensive area of Tasmania which is still relatively inaccessible to man, it must be remembered that because of the very limited nature of its preferred and rather specialised habitat, populations occur in only relatively small and semi-isolated areas within this range. With the large scale mineral and hydro development now taking place in western Tasmania and the provision of access roads, man's influence on the long unaltered environment is becoming increasingly evident. Extension of cattle grazing and the flooding of valleys for future hydro development will, in many cases, be removing forever some of the best *M. fuscus* habitat. The threat to its survival as seen by Calaby (1963) is increasing with state development and the small areas occupied by colonies, by their very nature, are likely to suffer in various ways as an effect of man's increasing penetration of western Tasmania.

The future of this little-known mammal is indeed threatened and its extinction can only be prevented by the preservation of large tracts of suitable wilderness, before the onrush of development brings a premature end to another interesting species.

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ACKNOWLEDGEMENTS

The author again wishes to express his thanks and appreciation to Mr. J. H. Calaby, Division of Wildlife Research, C.S.I.R.O., Canberra for his constant encouragement and help and for his criticism of the manuscript

Thanks are also due to Mr. Denison King of Port Davey who furnished me with information on the local fauna, to the Director and Zoological staff of the Tasmanian Museum for providing access to their collections and data, and to Mr. R. M. Warneke, Victorian Fisheries and Wildlife Department for advice and examination of the stomach contents of *M. fuscus*.

Grateful acknowledgement is also made for the financial assistance of a grant from the Science and Industry Endowment Fund, administered by the C.S.I.R.O., which has greatly facilitated the investigation.

I also wish to acknowledge the help given by my wife and family for their frequent and continuing attention to the captive animals and also to Mr. J. W. Swift of the Queen Victoria Museum technical staff who often accompanied me on field excursions and gave a great deal of his private time to assist the programme.

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FLORA OF ROCKY CAPE

by

M. J. FIRTH

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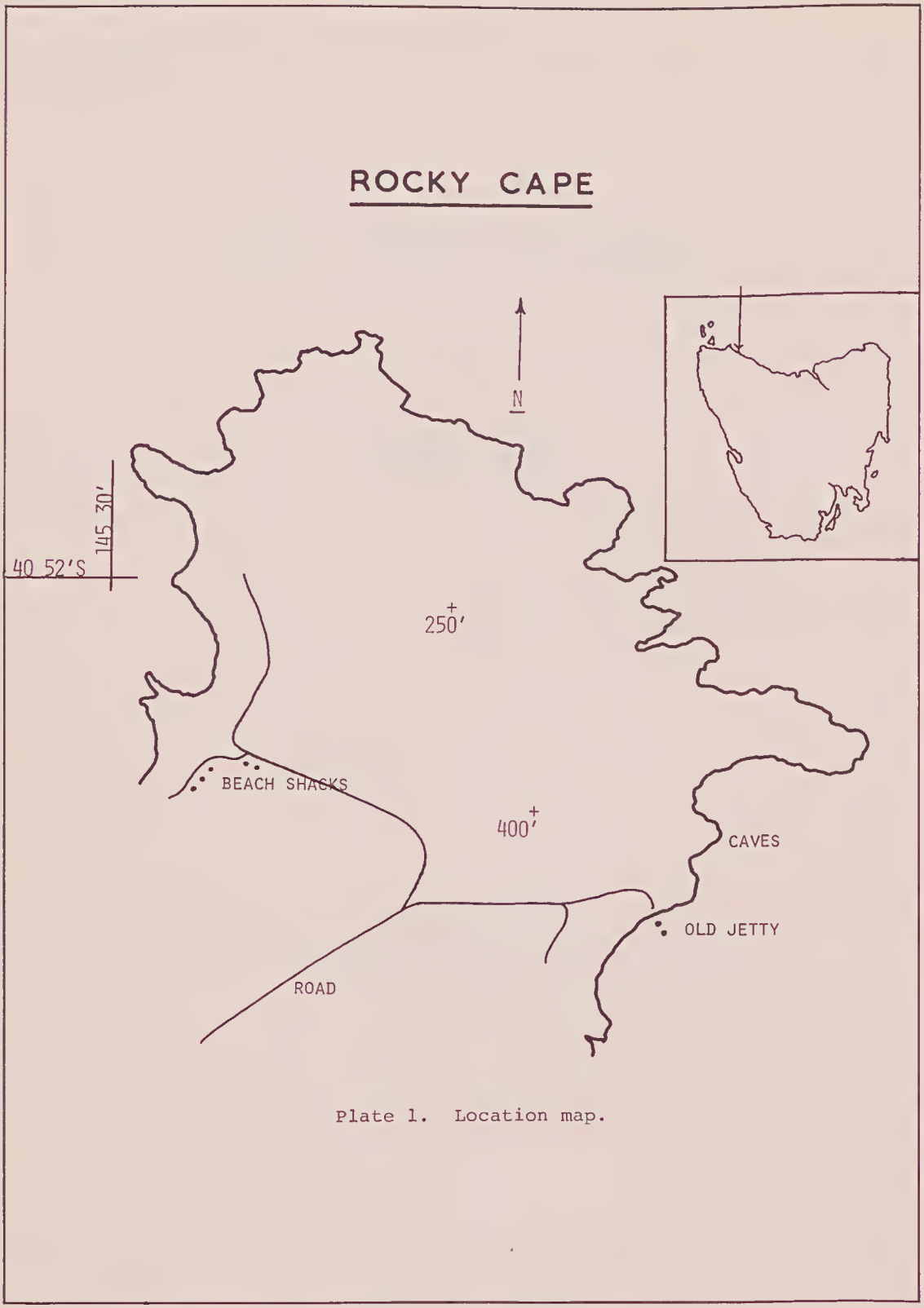

Plate 1. Location map.

FLORA OF ROCKY CAPE

by

M. J. FIRTH

Manuscript received 20/3/68. *Published 31/3/69.*

THE AREA

The area studied lies between the two branching roads at the extreme tip of the Cape. One of these roads skirts the eastern side of the Cape and terminates at the old Jetty; the other runs approximately west and leads to the beach shacks. Between these two roads lies a rocky and very hilly area of approximately 220 acres. To the east these hills are very steep, rising to 420 feet. Much of this area has abrupt cliffs containing several caves. Mounds of shells and bones, indicating the use of the caves by aborigines in early days, have been described by Rhys Jones in this journal (No. 25, 1966).

HISTORY

Rocky Cape was named by Matthew Flinders in 1798. In his *Voyage to Terra Australis* he states:

> "During the night, and the next day, of Dec. 5, the winds were light and variable, so that we made little progress. At noon, the furthest land seen to the westward appeared like a small flat-topped island, but being found connected with the mainland, received the descriptive name of *Circular Head;* a near projection, of a jagged appearance was called *Rocky Cape*, and a steep cliffy head, still nearer, *Table Cape*, from its flat top."

The region examined in detail here is at the extreme tip of Rocky Cape. Further inland, the land rises to form the Rocky Cape Range and a few miles to the east are the Sisters Hills. These two ranges run some miles inland. The hills themselves appear to carry vegetation which is very similar to that which they bore when first discovered. The vegetation of the basaltic region on both sides of the ranges has altered greatly, where clearing of the forest has opened up hundreds of acres of fertile farmland. An idea of the vegetation originally to be found in these adjacent areas can be gained from an early newspaper article (*Launceston Examiner*, 22 May 1890):

> "The Detention ... is separated from Sisters Creek by the Barren Rocky Cape Range, bare of the slightest vestige of timber, and the almost equally desolate range of the Sisters. It [i.e. the

> Detention region] has been known in the past as Dallas's Forest ... and a dark and gloomy forest it was when the first track was cut through it. Never have I seen such heavily timbered country in Tasmania, as at the eastern end of this forest, the trees being estimated at 70 to 120 per acre."

The article goes on to relate how a young man named Cassidy became lost in the dense forest near Detention River. His horse turned up later at a nearby bush settlement and a search party went out to look for the missing man. The article then states:

> "They found where he had tried to light a fire, but his matches were damp, where he had caught a glimpse of barren bauera-covered hills to the southward and made for them, though the only settlement lay northward and at last a fortnight after he was lost, they came upon the body of poor Cassidy, disfigured by native cats, where he had lain down to die, worn out with starvation and fatigue."

The earliest botanical collector at Rocky Cape was undoubtedly James Backhouse, a visiting Quaker missionary. The following entry from his journal for 13 December 1832 was published in *A Narrative of a visit to the Australian Colonies* (1843):

> "Here [at the Detention River] we halted, on a grassy place where there was a small spring, and made tea, while the horses grazed; they being relieved from their burdens, and tethered to the bushes. When the horses were a little rested, we ascended the white quartz hills, of Rocky Cape, which were but thinly covered with sandy peat. A species of *Xanthorrhoea*, or Grass-tree, is scattered over them, having a root-stock of a few inches high, supporting a crest of stiff spreading rushy leaves, from the centre of which rises a stem from 2 to 5 feet high, thickly covered, excepting a few inches at the base, with rough buds, and with flowers resembling little white stars. A beautiful *Blandfordia* was also scattered in this district: its stems were 1½ ft. high, and supported crests of from 10 to 20 pendulous, red blossoms, margined with yellow, 1½ inch long, and 3/4 inch wide, at the mouth.
>
> Beyond these hills is a level, upon which, and on some contiguous hills, *Banksia serratifolia* is the prevailing tree. This, so far as I know, is its only locality in V.D. Land. It is equal to a Pear-tree in size, has leaves 3 to 4 inches long, and 5/8 broad, and strongly toothed: its heads of flowers are 6 inches long, and 12 round; and the seeds are as large as almonds."

The old jetty near the tip of the Cape was built about 1890. At that time the present Bass Highway was little more than a track and land transport

was by horse and bullock wagon. Sea transport was used considerably in the carriage of goods to and from the farming settlements between the Ranges and Stanley. After the road was improved and motor transport became common in the 1920's, the jetties gradually fell into a state of disrepair and were probably burnt when they became dangerous.

According to an early settler, there has been practically no change in the vegetation of Rocky Cape since the 1890's, except that recurring fires have destroyed most of the older honeysuckles *Banksia marginata*. Even before white settlement, fires were probably used often by the aborigines while hunting wallabies and other game.

GEOLOGY

The Pre-Cambrian core, containing the oldest rocks in the State, is confined largely to the western half of the island. It extends from Port Davey through to Rocky Cape in an almost unbroken sequence. Although most rocks of this period have undergone great changes, the sediments of Rocky Cape have suffered little change. Here we find white quartz sandstones trending into interbedded siltstones and mudstones. The exposed strata show well-defined tilting and represent part of the large-scale folds common to the north-west coast. In places, fragmented sandstones have formed vegetation-stabilized screes and, in such areas away from the tip of the Cape, gravel pits are being worked.

SOILS

These fall into the group termed Skeletal Soils and Moor Podzol Peats, described by K. D. Nicholls and G. M. Dimmock in the *Atlas of Tasmania* (1965, p. 28) as follows:

> "The skeletal soils of Tasmania are characteristic of steep slopes on the more siliceous rocks, where weathered material is quickly removed by erosion. The soils are shallow and sandy with numerous rock fragments and varying accumulation of organic matter, and are strongly acid, leached and infertile. They are interspersed with frequent exposures of bare rock."

VEGETATION

By far the most extensive formation on the Cape is a low heath, in which many plants are adapted to dry conditions, but there are several quite wet areas where marsh plants flourish. There are two of these wet areas to the east. One of them opens out into a small pond, surrounded by shrubs and ferns. The other is a sedgy area, about two chains long, running down from an overhanging cliff. To the north-west are two similar marshy areas. Near the shacks, just behind the coastal sand dunes, is a pond 2 - 3 chains long

and a chain wide, where water lies even in the driest seasons. This pond gradually spreads out into an extensive marshy area to the west.

These wet areas occupy about 4 - 5 acres; the remainder being dry, rocky, exposed soil which dries out, particularly in summer. The shallow soil contains much acidic peaty material which has built up over many thousands of years. In these dry areas, plants have many different ways of protecting themselves from drought. Most plants are of uniform height for any quick-growing shoot raised above its surroundings is quickly dried off by the sea winds. In consequence of this wind-pruning, some of the older tea trees to the east have assumed an almost prostrate habit. Also, in dry conditions plants tend to economise in their use of water. The main loss is from their leaves, so that many have modified leaves to prevent this. Some of the plants on the Cape have almost dispensed with leaves to limit transpiration. An example of this is the so-called Native Broom *Amperea xiphoclada*. Although commencing life with typical feathery leaves, many of the acacias soon replace these with flattened leaf-stalks or phyllodes. Eucalypts are able to stand dry conditions quite well, since they have a row of hardened cells on both sides of the leaf. Many other trees have this hardened layer only on the side exposed to the sun, while the underside is quite different in appearance. It is to be noted, as well, that while young gum leaves are spread with one surface of their leaves to the sun, older trees have their leaves hanging vertically. Pigface *Carpobrotus sp.* stores water in succulent leaves; while *Aotus ericoides* has the leaves rolled so that the stomata will not transpire excessive amounts of water. Prickly Moses *Acacia verticillata*, in very exposed situations, assumes an almost prostrate habit, and since its leaves are replaced by spines, it is able to withstand very dry conditions.

With such modifications, plants on the Cape are well adapted to the testing conditions.

Among these hardy plants are to be found a few that are normally encountered in rain-forest areas. An outstanding example is Climbing Blueberry *Billardiera longiflora* and the Rocky Cape examples of this plant are the rarer type with pink berries. Another notable trespasser from the rain-forests is Native Elderberry *Sambucus gaudichaudiana* and yet another is *Notelea ligustrina*. *Blandfordia* is regarded as a plant usually found in mountain regions. Here it is to be seen growing prolifically almost down to high-water mark.

On the north-western margin, near the coast, is to be found what is possibly the biggest Sea Box *Alyxia buxifolia* extant. This single tree forms a thicket some twelve feet across and ten feet high.

The Cape is well endowed with orchid species, no other plant family

being nearly so well represented. Two very rare endemics are to be found in the region, the Tailed Spider Orchid *Caladenia echidnachila* and *Prasophyllum brachystachyum*. The former has labellum "tails" up to 3 cm long. They are by no means common; an occasional specimen turning up amongst some hundreds of *Caladenia patersonii*. *P. brachystachyum* was originally described from material collected by R. C. Gunn at Rocky Cape in the 1830's. It was then lost for over 100 years until rediscovered in 1946 near Stanley. The author again collected this orchid in 1965 and 1966.

Working from the early, brief descriptions, some botanists claimed to have found this orchid in Victoria. Later comparisons with fresh material have shown it to be a Tasmanian endemic species.

Another rather common orchid to be found here is *Corybas unguiculatus*, there being several small colonies hidden at the bases of heath and tea trees to the north. Just outside the area, to the east, is a magnificent colony of *Burnettia cuneata* with several hundred individual plants. On a plain some two miles inland is the only Tasmanian colony of *Microtis orbicularis*.

Eleven species of fern are to be found on the Cape. The most frequently occurring are: Bracken *Pteridium esculentum*, Kangaroo Fern *Microsorium diversifolium* and Screw Fern *Lindsaya linearis*. Near the pond to the east are localised areas of *Gleichenia*. There are two small areas of Shore Spleenwort *Asplenium obtusatum* in rocky nooks to the north and west continually drenched with salt spray.

Remarkably, few introduced plants have gained a foothold on the Cape. A few grasses, clovers, thistles, Scarlet Pimpernel *Anagallis arvensis*, and Mouse-eared Chickweed *Cerastium glomeratum* are to be seen but generally little introduced vegetation is to be found. Slender Thistle *Carduus tenuiflorus* has started to invade from the west and it will be necessary to keep a close watch on its spread to the east. In view of the relative unimportance of introduced plants they have been omitted from the appended census.

Besides the two orchids already mentioned, there are a number of other endemic Tasmanian species in this small area, namely *Lomatia tinctoria*, *Blandfordia punicea*, *Boronia variabilis*, *Leptospermum glaucescens* and *Eriostemon virgatus*.

CENSUS OF INDIGENOUS PLANT SPECIES ON ROCKY CAPE

Only vascular species have been included (ferns and seed-plants). Arrangement and nomenclature follow that of J. H. Willis in *Handbook to Plants in Victoria* Vol. 1 (1962) for ferns and monocotyledons, but that of Winifred M. Curtis *(Student's Flora of Tasmania* Parts 1-3, 1956-67) for all dicotyledons. Frequencies of occurrence are indicated by the following abbreviations

in italics after each name and authority. This system follows that used by J. H. Willis in his "Flora of the Nut," *Rec. Queen Vict. Mus.* No. 21, 1966.

c common and widespread
r rare
vr very rare (only 1 or 2 individuals noted)
loc localised
occ occasional or scattered

PTERIDOPHYTA

SCHIZAEACEAE

Schizaea fistulosa Labill. - *occ*

GLEICHENIACEAE

Gleichenia circinnata Swartz - *loc* (near waterhole on east)
G. microphylla R.Br. - *loc* (as above)

DENNSTAEDTIACEAE

Pteridium esculentum (Forst.f.) Nakai - *c*

LINDSAYACEAE

Lindsaya linearis Swartz - *occ*

POLYPODIACEAE

Microsorium diversifolium (Willd.) Copeland - *c* (amongst rocks)

ASPLENIACEAE

Asplenium flabellifolium Cav. - *occ* (E. slopes)
A. obtusatum Forst.f. - *vr* (rock crevices to N. & W.)

ASPIDIACEAE

Rumohra adiantiformis (Forst.f.) Ching - *r* (high rock crevices)

BLECHNACEAE

Blechnum minus (R.Br.) Ettingsh. - *loc* (near E. waterhole)

SELAGINELLACEAE

Selaginella uliginosa (Labill.) Spring - *occ* (swampy areas)

SPERMATOPHYTA

JUNCAGINACEAE

Triglochin procera R.Br. - *loc* (pond N.W.)

GRAMINEAE

Tetrarrhena acuminata R.Br. - *loc* (W. swampy area)
Poa australis R.Br. - *c* (near coast)
Amphibromus recurvatus J.R.Swallen - *r* (W. swampy area)
Dichelachne crinita Hook.f. - *occ*

Deyeuxia quadriseta (Labill.) Benth. - *occ*
D. densa Benth. - *occ*
D. scaberula Vickery - *r*
Agrostis avenacea Gmelin - *occ*
Danthonia caespitosa Gaudich - *occ*
D. pilosa R.Br. - *occ*
D. penicillata (Labill.) Pal. Beauv. - *occ*
Stipa teretifolia Steud. - *loc* (cliffs and shoreline)
S. elatior (Benth.) Hughes - *occ*
Hemarthria uncinata R.Br. - *occ*

CYPERACEAE

Scirpus nodosus Rottb. - *c*
S. fluitans L. - *loc* (W. swampy area)
S. cernuus Vahl. - *c*
Schoenus tenuissimus Benth. - *occ*
S. nitens (R.Br.) Poir. - *occ*
Machaerina acuta (Labill). J.H.Kern - *c*
Gahnia sieberiana Kunth. - *r* (near West coast)
Lepidosperma gladiatum Labill. - *occ* (against sea)
L. concavum R.Br. - *c*
Gymnoschoenus sphaerocephalus (R.Br.) Hook.f. - *loc* (swampy areas)

RESTIONACEAE

Restio tetraphyllus Labill. - *occ*
R. complanatus R.Br. - *occ*
Hypolaena fastigiata R.Br. - *c*
Calorophus lateriflorus (R.Br.) F.v.M. - *occ*

CENTROLEPIDACEAE

Centrolepis strigosa (R.Br.) Roem.&Schult. - *occ* (N. rocks)

XYRIDACEAE

Xyris operculata Labill. - *loc* (swampy areas)
X. marginata Rendle - *loc* (swampy areas)

JUNCACEAE

Luzula campestris (L.) DC. - *c*
Juncus maritimus Lam. - *occ*
J. pallidus R.Br. - *occ*
J. planifolius R.Br. - *occ*

LILIACEAE

Xanthorrhoea australis R.Br. - *c*
Lomandra longifolia Labill. - *c*
Chamaescilla corymbosa (R.Br.) F.v.M. ex Benth. - *occ*

Plate 2. Rocky Cape seen from the west. (Photo - author).

Plate 4. Rocky Cape, north-west Tasmania. Rugged eastern coast of Cape extremity, with steep ericoid shrubbery between escarpments and sea (aboriginal rock-shelters under bluff on top left-hand corner).
(Photo - J.H. Willis)

Plate 3. The author admiring a very extensive plant of Sea Box *(Alyxia buxifolia)* on the north coast of the Cape. (Photo - J.H. Willis).

Plate 5. White quartzite "fingers" entering sea from north-east extremity of Cape (Table Cape on horizon at centre). (Photo - J. H. Willis).

Blandfordia punicea (Labill.) Sweet - *c*
Thysanotus patersonii R.Br. - *occ*
Stypandra caespitosa R.Br. - *c*
Laxmannia sessiliflora Dene - *c*
Dianella tasmanica Hook.f. - *occ*
D. revoluta R.Br. - *c*
Caesia parviflora R.Br. - *occ*

IRIDACEAE

Patersonia fragilis (Labill.) Druce - *occ*
P. longiscapa Sweet - *occ*

ORCHIDACEAE

Thelymitra grandiflora FitzG. - *occ*
T. pauciflora R.Br. - *occ*
T. aristata Lindl. - *occ*
T. ixioides Swartz - *occ*
T. nuda R.Br. - *r*
T. truncata Rogers - *r*
T. venosa R.Br. - *loc* (swampy areas)
T. flexuosa Endl. - *occ*
T. cyanea (Lindl.) Benth. - *loc* (swampy areas)
T. rubra FitzG. - *occ*
Calochilus saprophyticus Rogers - *loc* (swampy areas)
C. robertsonii Benth. - *occ*
C. paludosus R.Br. - *loc* (N. swampy areas)
Diuris longifolia R.Br. - *occ*
Microtis unifolia (Forst.f.) Rchb.f. - *occ*
Prasophyllum elatum R.Br. - *occ*
P. gracile Rogers - *r*
P. brachystachyum Lindl. - *occ*
P. fuscum R.Br. - *r*
Chiloglottis reflexa (Labill.) Druce - *loc* (E. slopes)
Acianthus caudatus R.Br. - *occ*
A. reniformis (R.Br.) Schl. - *occ*
A. exsertus R.Br. - *occ*
Eriochilus cucullatus (Labill.) Rchb.f. - *c*
Lyperanthus nigricans R.Br. - *occ*
Burnettia cuneata Lindl. - *loc* (plain to east)
Caladenia menziesii R.Br. - *r*
C. dilatata R.Br. - *r*
C. patersonii R.Br. - *c*
C. echidnachila Nicholls - *r*

C. latifolia R.Br. - *r*
C. carnea R.Br. - *c*
Glossodia major R.Br. - *c*
Corybas aconitiflorus Salisb. - *c*
C. dilatatus (Rupp & Nicholls) Rupp - *loc* (north slope)
C. unguiculatus (R.Br.) Rchb.f. - *loc* (amid undergrowth to north)
Cryptostylis subulata (Labill.) Rchb.f. - *loc* (W. swampy area)
Pterostylis parviflora R.Br. - *c*
P. pedoglossa FitzG. - *c*
P. nana R.Br. - *occ*
P. pedunculata R.Br. - *occ*
P. nutans R.Br. - *occ*
P. longifolia R.Br. - *occ*
P. barbata Lindl. - *occ*
Gastrodia sesamoides R.Br. - *occ*
Caleana major R.Br. - *loc* (north slope)

DILLENIACEAE

Hibbertia procumbens (Labill.) DC. - *c*
H. sericea (R.Br.) Benth. - *c*
H. fasciculata R.Br. ex DC. - *occ*
H. acicularis (Labill.) F.v.M. - *r*

RANUNCULACEAE

Clematis microphylla DC. - *occ*

CRUCIFERAE

Cardamine heterophylla Hook. - *occ*
C. intermedia Hook. - *occ*

VIOLACEAE

Viola hederacea Labill. - *c*

PITTOSPORACEAE

Bursaria spinosa Cav. - *r*
Billardiera longiflora Labill. - *r* (N. coast)
Marianthus procumbens Benth. - *c*

TREMANDRACEAE

Tetratheca glandulosa Labill. - *occ*
T. ciliata Lindl. - *occ*
T. pilosa Labill. - *occ*

POLYGALACEAE

Comesperma volubile Labill. - *occ*
C. retusum Labill. - *r* (W. swampy areas)

C. calymega Labill. - *occ*

CARYOPHYLLACEAE

Sagina maritima G.Don. - *occ*

PORTULACACEAE

Calandrinia calyptrata Hook.f. - *occ*

LINACEAE

Linum marginale A.Cunn. - *occ* (west coast)

GERANIACEAE

Pelargonium australe Willd. - *occ* (near coast)

Geranium solanderi R.Carolin - *c*

OXALIDACEAE

Oxalis corniculata L. - *occ*

RUTACEAE

Correa alba Andr. - *occ*

C. backhousiana Hook. - *c*

Boronia variabilis Hook. - *c*

B. nana var. *nana* Hook. - *occ*

B. pilosa var. *laricifolia* Hook f. - *occ*

B. pilonema Labill. - *loc*

Eriostemon virgatus A.Cunn. ex Hook.f. - *occ*

STACKHOUSIACEAE

Stackhousia monogyna Labill. - *c*

S. spathulata Sieb. ex Spreng. - *occ* (sand against sea)

RHAMNACEAE

Pomaderris apetala Labill. - *loc*

MIMOSACEAE

Acacia verticillata var. *ovoidea* (L.Her) Willd. - *occ*

A. myrtifolia (Sm.) Willd. - *c*

A. suaveolens (Sm.) Willd. - *c*

A. mucronata Willd. - *occ*

A. sophorae (Labill.) R.Br. - *occ*

A. stricta (Andrews) Willd. - *loc* (N. coast)

A. botrycephala Desf. - *occ*

A. melanoxylon R.Br. - *r*

PAPILIONACEAE

Sphaerolobium vimineum Sm. - *r*

Gompholobium huegelii Benth. - *occ*

Aotus ericoides (Vent.) G.Don. -*c*

Pultenaea daphnoides Wendl. - *occ*

P. dentata Labill. - *occ*
Dillwynia sericea A.Cunn. - *c*
D. glaberrima Sm. - *occ*
D. cinerascens R.Br. - *c*
Platylobium obtusangulum Hook. - *c*
Kennedya prostrata R.Br. - *c*
Bossiaea cordigera Benth. - *occ*
B. cinerea R.Br. - *occ*
Lotus australis Andr. - *loc* (western sandbanks)

ROSACEAE
Acaena ovina A.Cunn. - *occ*
A. anserinifolia (J.R.&G.Forst.) Druce - *occ*

CRASSULACEAE
Tillaea sieberiana Schultes - *c*
T. macrantha Hook.f. - *c*

DROSERACEAE
Drosera auriculata Backh. ex Planch. - *c*
D. peltata Sm. - *occ*
D. binata Labill. - *loc* (swampy areas)
D. pygmaea DC. - *occ*
D. spathulata Labill. - *loc* (swampy areas)

HALORAGACEAE
Haloragis tetragyna (Labill.) Hook.f. - *c*
H. teucrioides DC. - *c*
H. micrantha (Thunb.) R.Br. - *occ*

MYRTACEAE
Calytrix tetragona Labill. - *c*
Baeckea ramosissima A.Cunn. - *occ*
Leptospermum scoparium Forst. - *c*
L. glaucescens S.Schauer - *c*
Melaleuca squarrosa Sm. - *occ*
M. squamea Labill. - *occ*
M. ericifolia Sm. - *loc* (swampy areas)
M. gibbosa Labill. - *loc* (near western pond)
Eucalyptus simmondsii Maiden - *occ*
E. ovata Labill. - *occ*

ONAGRACEAE
Epilobium billardierianum Ser. ex DC. - *occ* (swampy areas)

AIZOACEAE
Carpobrotus rossii (Haw.) Schwantes - *occ* (near coast)

Tetragonia tetragonioides (Pall.) Kuntze - *occ*

UMBELLIFERAE

Trachymene anisocarpa (Turcz.) Burtt - *c*

Xanthosia pilosa Rudge - *occ*

X. tridentata DC. - *loc* (nr. road junction)

X. pusilla Bunge - *occ*

Hydrocotyle hirta R.Br. ex Rich. - *c*

H. muscosa R.Br. ex Rich. - *occ*

Apium prostratum Vent. - *loc* (sea coast)

Centella cordifolia (Hook.f.) Nannf. - *occ*

Daucus glochidiatus (Labill.) Fisch. - *occ*

CAPRIFOLIACEAE

Sambucus gaudichaudiana DC. - *r*

RUBIACEAE

Coprosma hirtella Labill. - *r*

Opercularia varia Hook.f. - *c*

Galium australe DC. - *occ*

COMPOSITAE

Lagenophera stipitata (Labill.) Druce - *occ*

Olearia ramulosa (Labill.) Benth. - *occ*

Gnaphalium luteo-album L. - *occ*

G. involucratum Forst.f. - *occ*

G. japonicum Thunb. - *occ*

G. purpureum L. - *occ*

Helichrysum scorpioides Labill. - *c*

H. dealbatum Labill. - *occ* (wet soils)

H. bicolor Lindl. - *loc* (near coast)

H. apiculatum (Labill.) DC. - *occ*

H. dendroideum N.A.Wakefield - *occ*

Calocephalus brownii (Cass.) F.v.M. - *occ*

Cotula australis (Sieb. ex Spreng.) Hook.f. - *occ*

C. reptans Benth. - *loc* (near western pond)

Senecio lautus Forst.f. ex Willd. - *occ*

S. linearifolius A.Rich. - *occ*

S. minimus Poir. - *occ*

S. hispidulus A.Rich. - *occ*

Sonchus megalocarpus (Hook.f.) J.M.Black - *loc* (on coast)

STYLIDIACEAE

Stylidium graminifolium (Swartz.) ex Willd. - *occ*

GOODENIACEAE

Goodenia geniculata R.Br. - *c*

CAMPANULACEAE

Wahlenbergia quadrifida (R.Br.) A. DC. - *occ*

W. gracilenta N. Lothian - *occ*

LOBELIACEAE

Pratia pedunculata (R.Br.) Benth. - *loc* (wet places)

Lobelia alata Labill. - *loc* (marshy areas)

EPACRIDACEAE

Cyathodes oxycedrus (Labill.) R.Br. - *r* (near coast)

Leucopogon parviflorus (Andr.) Lindl. - *occ*

L. collinus (Labill.) R.Br. - *occ*

L. australis R.Br. - *occ*

L. virgatus (Labill.) R.Br. - *occ*

L. ericoides (Sm.) R.Br. - *occ*

Epacris impressa Labill. - *c*

E. lanuginosa Labill. - *loc* (wet areas)

E. obtusifolia Sm. - *loc* (wet areas)

Sprengelia incarnata Sm. - *loc* (wet areas)

Astroloma humifusum (Cav.) R.Br. - *occ*

PRIMULACEAE

Samolus repens (Forst. & Forst.f.) Pers. - *loc* (sea coast)

APOCYNACEAE

Alyxia buxifolia R.Br. - *occ* (near sea coast)

LOGANIACEAE

Mitrasacme pilosa Labill. - *c*

GENTIANACEAE

Villarsia reniformis R.Br. - *loc* (near western pond)

Centaurium australe (R.Br.) Druce - *occ*

CONVOLVULACEAE

Dichondra repens J.R.& G.Forst - *occ*

Convolvulus erubescens Sims - *occ*

SOLANACEAE

Solanum laciniatum Ait. - *occ* (nr. coast)

SCROPHULARIACEAE

Veronica derwentia Andr. - *occ*

LENTIBULARIACEAE

Utricularia dichotoma Labill. - *loc* (wet areas)

U. lateriflora R.Br. - *loc* (wet areas)

LABIATAE

Ajuga australis R.Br. - *r*

PLANTAGINACEAE

Plantago varia R.Br. - *occ* (grassy areas)

CHENOPODIACEAE

Rhagodia baccata (Labill.) Moq. - *occ* (coastal areas)

Salicornia quinqueflora Bunge ex Ung-Sternb. - *loc* (western coastal area)

Atriplex billardieri (Moq.) Hook.f. - *loc* (sandy beaches)

LAURACEAE

Cassytha glabella R.Br. - *occ*

C. pubescens R.Br. - *occ*

PROTEACEAE

Persoonia juniperina Labill. - *occ*

Banksia marginata Cav. - *c*

Lomatia tinctoria R.Br. - *loc* (near top of highest peak)

THYMELAEACEAE

Pimelea lindleyana Meissn. - *occ*

P. linifolia Sm. - *c*

SANTALACEAE

Leptomaria drupaceae (Labill.) Druce - *vr* (near shacks)

EUPHORBIACEAE

Poranthera microphylla Brongn. - *occ*

Amperea xiphoclada (Sieb. ex Spreng.) Druce - *c*

CASUARINACEAE

Casuarina monilifera L.Johnson - *occ*

BRYOPHYTES

As an addendum to this paper, Mr. J. H. Willis, Assistant Government Botanist for Victoria, has kindly furnished the following brief report on the bryophyte flora (mosses and hepatics) of Rocky Cape:

On the afternoon of 4 January 1967, the opportunity was taken to collect whatever mosses and hepatics were then in evidence on rock, earth or wood around the terminal hills of the Cape. The three lichens *Caloplaca ?cinnabarina* (abundant on quartzite surfaces as an orange-red encrustation), *Cladia aggregata* and *C. retipora* were also taken; but the time available was far too short to make any significant collection of the lichen flora. Very few fungi were seen at the height of the dry summer season, so no attempt was made to list the species in this large, diverse group.

Rocky Cape appears to have a rather limited moss flora, poor in comparison with that on The Nut to the north-west and Table Cape to the east. No *Bryum*, *Fissidens* or *Lembophyllum* has yet been noted, although these genera

are well represented on both of the higher above-mentioned headlands. Doubtless, an intensive search during springtime would augment the moss list for Rocky Cape to some extent; but its very different geological structure - quartzite as against basalt - is an important reason for this poverty. Nevertheless, the few bryophytes that were observered in January 1967 are intriguing from a distributional aspect. Out of nineteen species collected at Rocky Cape, seven (or 37%) have not yet been seen on the bryologically much richer basaltic bluffs of Table Cape (40 known species) and The Nut* or Circular Head (35 species).

Of particular interest are the mosses *Dicranoloma menziesii* and *Dicranoweisia antarctica*. The former is normally an inhabitant of shaded fern-gullies, while the latter is typically subantarctic and was unknown from any part of Australia until the writer collected samples on the dolerite summit of Mt. Field West (4,700 ft) in December 1952; it occurs also at Macquarie Island and on high New Zealand peaks, but an occurrence on Bass Strait, at sea level, was quite unexpected. Incidentally, this Rocky Cape collection is in excellent fruit and more robust than usual. *Sphagnum subsecundum*, Bog Moss, was abundant in damp peaty areas between the hills; it is absent from The Nut and Table Cape (where comparable sandy heathland is lacking), as also apparently are the two hepatics *Cuspidatula monodon* and *Jamesoniella colorata*.

LIST OF SPECIES

MUSCI (Mosses)

Breutelia affinis (Hook.) Mitt.
Campylopus introflexus (Hedw.) Brid.
C. bicolor (Hornsch.) Hook.f.
Dicnemoloma sieberianum (Hornsch.) Ren.
Dicranoloma billardieri (Schwaegr.) Paris
Dicranoweisia antarctica (C.Muell.) Paris
Rhacopilum convolutaceum (C.Muell.) Mitt.
Rhynchostegium tenuifolium (Hedw.) Jaeg.
Sematophyllum homomallum (Hampe) Broth.
Sphagnum subsecundum Nees
Thuidium furfurosum (Hook.f. & Wils.) Jaeg.
Tortella calycina (Schwaegr.) Dixon
Zygodon intermedius Bruch & Schimp.

HEPATICAE (Liverworts)

Cuspidatula monodon (Hook.f. & Tayl.) Steph.
Frullania falciloba (Tayl.) Tayl.
Jamesoniella colorata (Lehm.) Spruce
Lophocolea semiteres (Lehm.) Mitt.
Metzgeria furcata (L.) Dumort.

*See these *Records* No. 21, pp 4 & 8 (1966).

ACKNOWLEDGMENTS

I must first express my thanks and appreciation for the help and encouragement accorded me by Mr. J. H. Willis, Assistant Government Botanist at the Melbourne Herbarium. He originally suggested the project to me, and has done much to help bring about its fruition.

The Lands and Surveys Department provided maps and the State Library supplied reference material about Rocky Cape.

I wish to thank Mr. T. E. Burns for helpful notes; Mr. H. J. King for copying of photographs; Mr. Charles Turner for assistance in checking identifications. Mr. Maurice Sampson's valuable reminiscences of the early days of Circular Head proved of interest and value to me.

Mr. B. P. Alford has very helpfully provided notes on the geology of the area; and Mrs. B. P. Alford has prepared map work.

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NATIONAL MUSEUM
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OF VICTORIA

THE BIRDS OF FLINDERS ISLAND

by

R. H. GREEN

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RECORDS OF THE
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Figure 1. Flinders Island, largest of the Furneaux Group. Places mentioned in the text are as follows:

1 Smith's Gully
2 "Dallen"
3 Memana
4 Fisher Island
5 Strzelecki Peaks
6 Lackrana
7 Emita
8 Trousers Point
9 Tin Kettle Island
10 Cat Island
11 Locotta
12 Scotts Lagoon
13 Cameron Inlet
14 Whitemark
15 Rabbit Island
16 Isabella Island
17 Storehouse Island
18 Spence's Reef
19 Settlement Point
20 Mt. Chappell Island
21 Marshall Bay
22 Patriarch Creek
23 Billy Goat Reef
24 North-east River
25 Adelaide Bay
26 Pat's River Aerodrome
27 Brodies Lagoon
28 Anderson Island (= Woody Island)
29 Logan Lagoon
30 Roydon Island
31 Altmoor
32 Cape Barren Island
33 Lady Barron
34 Killiecrankie
35 Palana
36 West Sisters Island
37 Blue Rocks
38 Babel Island
39 Dog Island
40 Briggs Islet

THE BIRDS OF FLINDERS ISLAND

WITH REFERENCES TO OTHER EASTERN BASS STRAIT ISLANDS AND ANNOTATED LISTS OF OTHER VERTEBRATE FAUNA

by

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Manuscript received 3/5/69. *Published 30/6/69.*

ABSTRACT

A study of the birds on Flinders Island was undertaken by the Queen Victoria Museum during four visits in 1966 and 1967. As a result 128 bird species are recorded from Flinders Island and its coastal waters. Limited collecting has resulted in the acquisition of 166 bird skins of 41 species. An additional nineteen species have been acquired by other means.

Eighty-eight species have been found to breed locally.

Pastoral development of the island is reducing the natural habitat but most species remain plentiful in unaffected areas. Species dependent on open grassland have benefited from land clearing; plovers and the introduced sky lark have increased greatly. The Cape Barren goose also appears to have increased considerably and to be benefiting from pasture improvement which is providing it with a better diet.

A number of species appear to have been incorrectly included in the island's avifauna. Some sedentary species which occur both in south-eastern Australia and Tasmania are absent and some common trans-Bass Strait migrants apparently occur as transitory species only.

Observations on the mammals, amphibians, reptiles and freshwater fishes are also recorded.

INTRODUCTION

Flinders Island is the largest of the Furneaux Group, which consists of about fifty islands in eastern Bass Strait. These islands were connected to Tasmania and Victoria by land bridges when the sea level dropped during the Pleistocene (Jennings 1959) and in Tertiary times (Bock and Glenie 1965).

Their present isolation as islands makes the affinities of their fauna of particular interest, while their geographical position is also significant because it makes them obvious "stepping stones" for birds which migrate between Victoria and Tasmania.

The ecology and evolution of the avifauna of the area are discussed by Ridpath and Moreau (1966) and Serventy (1967) discusses the Bass Strait islands and their fauna. The geology of Flinders Island has been studied by Kershaw and Sutherland (unpub. ms.). The Victorian Field Naturalists Club visited the area in 1893 (Gabriel 1894). The Australasian Ornithologists' Union visited the Furneaux Group in the course of an expedition to the islands of Bass Strait in 1908 (White 1909) and a 24-page pictorial coverage of the places visited was published by the A.O.U. in 1908. Nevertheless, published observations of the island's avifauna remain few.

With the advent of modern land clearing methods, agricultural development is rapidly reducing the natural environment and extensive areas of swamp land and other natural habitats have been replaced by open pastoral land sown to introduced grasses (Pryor 1967*a*).

To gain a more extensive knowledge of the local fauna, the author made four visits to Flinders Island and collected specimens and information wherever possible. The first visit was from 14 - 25 March 1966 when, with the assistance of J. W. Swift, Technical Assistant, a series of 131 birds covering 29 species was collected for the Queen Victoria Museum, Launceston with a few mammal, amphibian, reptile and fish specimens. A number of field observations were made on the birds. Succeeding visits were made by the author alone during 10 - 16 November 1966, 18 - 23 September 1967 and 23 - 27 November 1967 when 35 bird skins comprising 12 bird species were added to the former series with other vertebrate species.

METHODS AND SOURCES OF DATA

Collecting in March was carried out in two areas; Bob Smith's Gully in the foot hills of the Strzelecki ranges and on "Dallen," the no. 1 settlement block at Memana (see map figure 1, plates 1 and 2 and description of sites below). Selected specimens were collected by shooting and netting, the surplus netted birds being released unharmed after examination.

Standard measurements, breeding and age data, stomach contents, and ephemeral colours of the specimens were recorded and searches made for both external and internal parasites. A number of species were observed and recorded in addition to those collected.

Reliable observers who have resided on Flinders Island for varying periods were interviewed and their observations and opinions are acknowledged in the species list. They include Mr. David Rhodes (D.M.R.), Mr. Alex Dalgleish (A.D.), Mr. John Nield (J.B.N.), Mrs. Iola Fowler (R.M.F.) and Mr. Athol Dart. Mr. A. D. Selby of Gunbower, Victoria spent two weeks on the southern end of Flinders Island towards the end of November 1952 and he has kindly supplied me with a copy of the species list he made on that occasion. All references to his sightings are confined to that visit.

It is natural that some migratory birds, additional to those species mentioned in the text, do occur in the area but unless such occurrences have been reported by a competent observer they have been omitted from the present list. Though the original area of the investigation was Flinders Island, additional references have been cited for other Bass Strait islands when considered of sufficient importance to warrant inclusion.

The bird nomenclature follows that of the Royal Australasian Ornithologists' Union (1926) with subsequent amendments. Names are followed by * if the occurrence of the species is undoubted, or (*) if one or more locally collected specimens are held in the collections of the Queen Victoria Museum. "B" is added if the species is known to be a local breeder. If the name is not followed by an asterisk, the occurrence is noted as doubtful and requiring more positive confirmation before its inclusion in the list of local avifauna is justified.

HABITAT

Flinders Island is approximately 40 miles long and 15 miles wide. The terrain is irregular, rising to 2,500 feet with prominent, bare granite outcrops. The soils are mostly sandy and vary greatly in fertility. The

island lies within the 20 to 40 inch rainfall region with July and August usually being the wettest and coldest months (mean 43°) and January and February generally the driest and hottest (mean 70°). A detailed account of the soils of Flinders Island, with a brief history, description of the physical environment and related comments, is given by Dimmock (1957). Serventy also discussed rainfall and climate of the area in relation to the Fisher Island field station and Willis and Guiler give details of the Fisher Island vegetation and intertidal ecology (Guiler, Serventy and Willis 1958).

Development has taken place mainly on the central and western parts of the island and much of the eastern half remains undeveloped and inaccessible by roads. About half the island is considered not worth development at present. Some details of land development and land usage are given by Pryor (1967*b*).

Though much of the island remains undeveloped, there are extensive areas which have been cleared recently and laid down to improved pasture. As an example, the Memana settlement was once an extensive undulating area of cutting rushes, heaths and grass trees, interspersed on the rising ground with dense tea-tree, stunted she-oaks, honeysuckles and heath. In the last ten years about 60,000 acres have been cleared, ploughed and sown with introduced grasses for grazing. A sample collected from a small section of unimproved country on "Dallen" has been lodged in the collections of the Queen Victoria Museum and includes spreading wattle (*Acacia diffusa*), honeysuckle (*Banksia marginata*), dagger hakea (*Hakea teretifolia*), tea-tree (*Kunzea ambiqua*), manuka tea-tree (*Leptospermum scoparium*), native wallflower (*Pulteneae subumbellata*), two epacrids (*Epacris impressa* and *E. squarrosa*), cutting rush (*Gahnia psittacorum*) and an undetermined rapier sedge. Land development is also proceeding in other parts of the island where the lowland areas, in their native state, carry a range of vegetation varying according to the soil types on which it grows. Included are she-oaks (*Casuarina* spp.), honeysuckles (*Banksia* spp.), tea-tree (*Leptospermum* spp. and *Melaleuca* spp.), grass tree (*Xanthorrhoea australis*), cutting rush (*Gahnia psittacorum*), stunted eucalypts, heaths and sedges. A comprehensive account of the vegetation on the various soil types is given by Dimmock (1957).

The undeveloped hill country supports mainly dry sclerophyll forest, dominated by eucalypt species with an under-storey of mixed scrub. The gullies generally carry a rain forest type of vegetation. The upper mountain slopes are generally steep and barren with little or no vegetation.

Smith's Gully (see plate 1), which was the camp site from 14 - 22 March 1966, is a fertile valley about a mile long by a quarter mile wide, the floor of which has been sown to improved pasture for some time. Its altitude is about 200 feet and it is enclosed on three sides by steeply ascending hills which give rise to the Strzelecki ranges. A small, swift-flowing creek drains through the valley and its banks support a tall, relict rainforest vegetation.

The Memana camp site from 22 - 25 March 1966 was on the property of Mr. A. Dalgleish (see plate 2). It was adjacent to the homestead and surrounded by open, highly developed pasture land at an altitude of about 150 feet. These paddocks border an extensive area of undeveloped hill country which, one week before our arrival, had been subjected to one of the largest bush fires the island has suffered. About a quarter of the island was burnt out, the fire being so hot that it scorched the upper foliage of the tallest eucalypts, which reach to approximately 150 feet. It was on the edge of this burn, in small patches of scrub inside a fire break, that we conducted most of our collecting in this area.

BIRD SPECIES LIST

5. Little Penquin *Eudyptula minor* *B. Occurs in large numbers in Bass Strait and breeds in burrows on many small islands often in company with muttonbirds (*Puffinus tenuirostris*) but no breeding sites are known on Flinders Island. This bird is illegally slaughtered for crayfish bait by a small element of the fishing community.

9. Stubble Quail *Corturnix pectoralis* (*)B. A few present in small bevies. A female (reg. no. 1966/2/160), which was sitting on eight slightly incubated eggs, was killed by a mower at Lackrana on 16 December 1966 during harvesting operations. A pair had been seen and heard in the immediate vicinity for some days previously.

10. Brown Quail *Synoicus ypsilophorus* *B. Occurs throughout the island and appears to be increasing. Bevies in excess of 100 birds have been seen in recent years (D.M.R.) It is very numerous on some of the smaller offshore islands. Small bevies were regularly seen at Smith's Gully.

14. Painted Quail *Turnix varia* (*)B. Not common but its presence and breeding were confirmed by feathers, egg shells and a specimen (reg. no. 1966/2/140) was collected in May 1966. A clutch was successfully reared by a pair of painted quail in Mrs. R. M. Fowler's garden at Emita in 1964 (R.M.F.) One was collected by the R.A.O.U. in 1912 (White and Mellor 1913).

34. Common Bronzewing *Phaps chalcoptera*. Selby's list includes "two seen at Emita."

35. Brush Bronzewing *P. elegans* (*)B. Fairly plentiful throughout the tea-tree scrub and forest areas of the island. It was often seen and heard calling in the tea-tree scrubs near Lackrana.

45. Lewin Water-rail *Rallus pectoralis* *B. A few in the swamplands but appear to be generally decreasing with drainage and land development (D.M.R.) A nest containing 6 eggs was found at Trousers Point in 1936 (J.B.N.) Birds answering this description occur on nearby Tin Kettle Island (D.M.R.) Cashion (1958) found them on Cat Island.

56. Dusky Moorhen *Gallinula tenebrosa* (*)B. A subadult male (reg. no. 1968/2/209) was shot by mistake for a duck at Patriarchs Inlet on 12 April 1968. It was feeding with black ducks at the time. This follows numerous reports that the species occasionally occurs and breeds on Flinders Island. Rhodes and Nield both state that they have seen it and found its nests with eggs in the Locotta swamp before draining in 1956. K. A. Hindwood and R. Wheeler report sighting two on Scott's Lagoon in November 1948 (Sharland 1958). The Queen Victoria Museum collections include a set of three eggs taken near Trousers Point about 1935 which are consistent with those of this species. It does not occur in Tasmania.

58. Eastern Swamphen *Porphyrio melanotus* *B. A common bird throughout the wetlands of the east coast. A number of nests with eggs, some just hatching, were found in the burnt out tea-tree swamps near Lackrana during my November 1966 visit. The adults were shy and difficult to sight.

59. Coot *Fulica atra* (*)B. Now occurs only spasmodically but was once seen and found breeding fairly regularly in the lagoons and swamps at Loccota. No nests have been found since this land was drained in 1956 (D.M.R.) The Queen Victoria Museum has a set of six eggs collected at Trousers Point about 1935. Selby saw this bird on Scotts Lagoon.

60. Great Crested Grebe *Podiceps cristatus* *. Two were seen by the author in Cameron Inlet on 21 September 1967.

62. Hoary-headed Grebe *P. poliocephalus* *B. Occurs spasmodically on lagoons (D.M.R.) and 2 nests with eggs were found by Nield in the Locotta swamp on Trousers Point in October 1938 (J.B.N.) None were seen on either of my visits in 1966 but three were found in Cameron Inlet on 21 September 1967. Selby saw one near Whitemark.

65. White-faced Storm-petrel *Pelagodroma marina* (*)B. Le Souef (1902) records a rookery on Rabbit Island (probably Briggs Islet) which, in the latter half of November 1901, contained birds with fresh or slightly incubated eggs. Mellor and White (1913) and Wheeler (1949) record similar observations. Gabriel (1894) records a rookery on Isabella Island on 11 November 1893. Atkins (1909) found a rookery on Storehouse Island. Duncan Macdonald (pers. comm.) found over 100 nests with eggs on Spence's Reef on 16 November 1959. The author found many hundreds with eggs on Forster Island off north-eastern Tasmania on 6 December 1966 (unpub. data).

71. Short-tailed Shearwater *Puffinus tenuirostris* (*)B. The only known rookery on Flinders Island is about 2 acres in extent at Settlement Point, Emita, but it breeds in vast numbers on nearby islands. Four to five hundred thousand nestlings are "commercially harvested" each year from rookeries controlled by the Tasmanian Animals and Birds Protection Board but, despite this human predation, most rookeries are expanding. Gabriel (1894) and Campbell (1894) give some details of early visits. Serventy (1957 *a*, *b*; 1958 *a*, *b*; 1960) gives some results of his investigations. Warham (1960) studied the species on Cat Island in 1957-58. The vegetation of the Fisher Island field station is described by Gillham (1965) who also discusses some associated effects of the bird population. An unpublished field report of M.T.L.E. Vogelpoel on a visit to Mt. Chappell Island in February 1964 states in part "The young muttonbirds suffered however, as the downpour could not be absorbed quickly enough and many of the burrows filled with water, and the young birds had to leave their 'safe' hideouts. Outside they were exposed to the vicious attacks of seagulls. We spent several hours trying to save as many young muttonbirds as we could but without much success." An albino subadult (reg. no. 1963/2/24) was collected during the 1963 season.

75. Great-winged Petrel *Pterodroma macroptera* (*). A recently dead beach-washed specimen (reg. no. 1968/2/227) was found at Marshall Bay on 13 August 1968 and sent to the Queen Victoria Museum by John Whinray. Upon dissection it was found to be an adult male in very low condition. Its gut contained a piece of material consistent with the flesh of a squid or cuttlefish. The following measurements were recorded: Weight 415 gm, total length 410 mm, wing 286, wing spread 1030, tail 123, tarsus 44.7, middle toe (ex. claw) 59.3, beak (to base of skull) 50.7, testes 4 x 3.

77. White-headed Petrel *P. lessonii* (*). A recently dead beach-washed specimen (reg. no. 1968/2/219) was collected by Rhodes on 1 June 1968 and forwarded to the author. Upon preparation it was found to be in very low condition, and the gut to contain beaks and remains of beaks of 31 small cuttlefish. A dessicated beach-washed specimen (reg. no. 1969/2/19) was collected by D.G.F. Smith in 1968. Only two other specimens have been collected in Tasmanian waters (Wall 1956).

79. Giant Petrel *Macronectes giganteus* *. Known to occur in the area. Mattingley (1938) saw several on his visit to the Kent Group. Cashion

(1958) saw a single bird off Cat Island on 15 March 1958.

80. Cape Petrel *Daption capense* (*). Rhodes found a freshly dead specimen on the Loccota beach in January 1956. It was sent to the Queen Victoria Museum and mounted for display (reg. no. 1956/2/1). Cashion (1958) recorded this species as seen from the boat, several miles south of Cat Island on 14 January 1958.

83. Fairy Prion *Pachyptila turtur* *. This species is known to occur in the area and has been found breeding on North-east Island in the Kent Group (Mattingley 1938) and other places round the Tasmanian coast (Macdonald and Green 1964, Green and Mollison 1961). Wheeler (1949) found a dead bird on Rabbit Island (= Briggs Islet) and suggests they possibly breed there. Macdonald collected a beach washed specimen with aberrant plumage in February 1957.

84a. Thin-billed Prion *P. belcheri* (*). On 18 July 1967 John Whinray found an adult female which was freshly dead on the beach of Marshall Bay on the west coast. It was in low condition and the skin (reg. no. 1967/2/15) was placed in the Queen Victoria Museum.

85. Diving Petrel *Pelecanoides urinatrix* (*). Thousands were feeding off the east coast of Flinders Island in mid July 1968 (pers. comm. John Whinray) and a specimen (reg. no. 1968/2/226) was secured. Breeding rookeries have been recorded on Black Pyramid in western Bass Strait (Green and Macdonald 1964) and North-east Island in the Kent Group (Mattingley 1938).

88. Black-browed Albatross *Diomedea melanophris* (*). Cashion (1958) recorded this species several miles south of Cat Island on 14 January 1958. A recently dead beach washed specimen (reg. no. 1968/2/228) was collected on Marshall Bay beach on 25 August 1968 and sent to the Queen Victoria Museum by John Whinray.

91. White-capped Albatross *D. cauta* *. Often seen some distance off-shore. It breeds on Albatross Island in western Bass Strait and the Mewstone off southern Tasmania (Macdonald and Green 1964).

96. Black Cormorant *Phalacrocorax carbo* *B. Not commonly seen but, for the past 30 years, a small colony of up to 20 pairs has been known to breed in association with little pied cormorants in the dense tea-tree lining the edge of a swamp in the south-east of the island. On the occasion of my visit to the area in November 1966 a few birds were at the nesting site but no eggs or young could be found. The extensive fires of the previous summer apparently had prevented the birds from breeding, as much of the nearby tea-tree had been burnt. (see plate 3) Three were seen in Cameron Inlet on 21 September 1967.

97. Little Black Cormorant *P. ater* *. Rarely recorded. A few were seen for a short period near Loccota about 1960 (D.M.R.)

98. Black-faced Cormorant *P. fuscescens* *B. Common round the coast and breeds on the offshore islands. It often comes into the inland lagoons to roost at night (D.M.R.) A rookery on Storehouse Island, off the east coast is mentioned frequently in the literature of Bass Strait birds. Barrett (1925) gives a photograph of the rookery with birds at the nests.

100. Little Pied Cormorant *Microcarbo melanoleucus* *B. Occasionally seen on the lagoons and inlets. A few pairs have been known to breed in association with black cormorants in thick tea-tree on the edge of a

swamp in the south-east of the island for the past 30 years. Though birds were present on the occasion of my visit in November 1966, breeding had apparently been prevented because of the nearby fires of the previous summer. (see plate 3) Twenty were seen near Whitemark on 20 September 1967.

104. Australian Gannet *Sula serrator* *B. Often seen offshore. It breeds on several islands in Bass Strait and off southern Tasmania (Green and Macdonald 1964, McKean 1966). The once extensive Cat Island rookery is now virtually non-existent. Gabriel (1894) shows a photograph of the rookery taken in 1893 when he estimates about 2,500 nesting birds were present and gives an account of his visit. Further details are given by Campbell (1894) and White (1909). Atkins (1909) estimated 5,000 - 7,000 birds were nesting in the rookery in November 1908. Anderson (1936) found 800 to 1,000 birds nesting in 1935. Serventy (1949), Warham (1958) and Cashion (1958) give accounts of more recent visits when only a few birds remained. Only 12 pairs bred on Cat Island in the 1966-67 season (Vincent Serventy pers. comm.). More than 20 could be seen seawards from Patriarch Creek on 21 September 1967.

106. Australian Pelican *Pelecanus conspicillatus* *. Up to 20 can often be seen in Cameron Inlet and lesser numbers in other sheltered waters round the coast. It breeds on a number of small islands in Bass Strait, Forster Island off north-east Tasmania being the most notable.

112. Caspian Tern *Hydroprogne caspia* *B. A few birds all round the coast. Breeds on offshore islands and on two tidal islands in Cameron Inlet where, on 25 November 1967, a single egg which appeared to be freshly laid was found on the sand just above the high water line.

114. White-fronted Tern *Sterna striata* *. Le Souef (1902) recorded it from the Furneaux Group but gives no locality. Duncan Macdonald (pers. comm.) has seen this species round Flinders Island on various occasions.

115. Crested Tern *S. bergii* *B. Often seen all round the coast and breeds on various offshore islands. On 16 November 1959 Macdonald (pers. comm.) found 76 nests with eggs on Billy Goat Reef, and up to 180 nests with eggs on Spence's Reef. A flock of about 30 were resting on the shore of Cameron Inlet during a period of high winds on 25 November 1967.

118. Fairy Tern *S. nereis* *B. Though not common, this species is regularly seen round the coast and I saw several at Cameron Inlet and Patriarch Creek in November 1967. Despite the apparent suitability of the area I did not find any evidence of breeding. Macdonald (pers. comm.) observed 36 at North-east River on 15 November 1959 and found three nests each with a single egg, apparently well developed.

125. Silver Gull *Larus novaehollandiae* (*)B. Very common all round the coast, it also ventures over most of the island's agricultural areas where it comes to feed on grasshoppers and other pasture pests. Several hundred pairs breed annually on the tidal islands in Cameron Inlet. It also breeds in considerable numbers on many small Bass Strait islands. Hundreds were resting in sheltered paddocks near Whitemark on our visit in March 1966.

126. Pacific Gull *L. pacificus* *B. Common all round the coast and occasionally odd birds come inland. It breeds on most of the offshore islands.

126a. Dominican Gull *L. dominicanus* *. J. H. Calaby (pers. comm.) observed a single bird from the "Magga Dan," on the evening of 23 November 1960.

It was first seen while within sight of Flinders Island and it followed the ship, in company with silver gulls and pacific gulls, for over an hour.

128. Arctic Skua *Stercorarius parasiticus* Le Souef (1902) records it from the Furneaux Group but gives no locality.

129. Turnstone *Arenaria interpres* *. Three were seen on the tidal flats at Patriarch Creek on 22 September 1967, one still retaining prominent breeding plumage. Three were seen by Selby on the flats at Adelaide Bay.

130. Pied Oystercatcher *Haematopus ostralegus* *B. Occurs on most sandy beaches and tidal mudflats. It breeds in the littoral zone above the beaches on Flinders and nearby islands. A nest with two eggs was found on a small sand dune at Patriarch Creek on 22 September 1967. In the summer of 1966 several were seen feeding on pasture parasites in paddocks adjacent to Cameron Inlet (D.M.R.)

131. Sooty Oystercatcher *H. unicolor* *B. Occurs all round the coast but breeding is mostly confined to the littoral zone above the rocky shoreline. It is more shy in the selection of its nesting sites than the preceeding species. Twenty were seen on the beach near Whitemark on 20 September 1967.

133. Spur-winged Plover *Lobibyx novaehollandiae* (*)B. Very common on all the grasslands and increasing with pastoral development. Flocks of up to 200 are not unusual in the agricultural areas. Breeding was found to be well advanced on my September visit with eggs and small runners numerous.

135. Banded Plover *Zonifer tricolor* (*)B. First noticed about 1930 when a few were seen at "Kentdale," Emita (D.M.R.) They have since increased and spread with pastoral development. Every autumn for some years a few have appeared in the paddocks on "Dallen," Memana and in March 1968 this congregation increased to about 50 (A.D.). Several small groups were present during our March visit. They were commonly seen at many places on the island during my September visit and breeding was well advanced. Several pairs were seen with small runners and at least three pairs were breeding on the Pat's River aerodrome.

138. Hooded Dotterel *Charadrius cucullatus* *B. A few pairs are present on most of the coastal beaches of Flinders Island and adjacent islands where it breeds in the littoral zone. A nest containing three eggs was found on an island in Cameron Inlet on 25 November 1967 and another with a similar complement at Patriarch Creek the following day.

140. Double-banded Dotterel *C. bicinctus* *. One was seen in March on the beach of Cat Island by Cashion (1958). A flock of about 30 birds (probably this species) was seen in a cultivated paddock on "Dallen," Memana by Dalgleish in April 1965 and again in April 1966. They did not stay long and apparently were newly arrived migrants. Similar flocking in a cultivated paddock by newly arrived migrants in March was observed by the author near Longford, northern Tasmania in 1960 when in excess of 100 were found feeding over a 30 acre paddock. They likewise remained for only a day.

143. Red-capped Dotterel *C. alexandrinus* *B. Common on all coastal beaches and breeds in the littoral zone. About 30 were resting with other waders, on the gravel verges of the Pat's River aerodrome on my September visit and the groundsman informed me that they occasionally nest there. It sometimes moves inland and may be seen on the shores of the receding

lagoons.

149. Eastern Curlew *Numenius madagascariensis* *. Seen on coastal mudflats and inlets on occasions (D.M.R) Several were seen by Selby on the flats in Adelaide Bay. Two were seen at Patriarch Creek on 22 September and several were there on 27 November 1967.

150. Whimbrel *N. phaeopus* *. One seen by Selby in Adelaide Bay.

153. Bar-tailed Godwit *Limosa lapponica* *. Seen by Selby on the flats in Adelaide Bay. Several godwits (species not determined) were present on the same flats when I visited the area on 26 November 1967.

158. Greenshank *Tringa nebularia* (*). Selby found it numerous on the flats in Adelaide Bay. At least one was present on 26 November 1967 and two (reg. no. 1968/2/213 - 214) were collected on 27 May 1968. Both birds, though apparently healthy, were in low condition and carried no obvious fat deposits. The stomachs were found to contain small fish (*Gobius* sp.)

161. Curlew-sandpiper *Erolia ferruginea* (*). Four were on the gravel verges of the Pat's River aerodrome, together with some waders, on 20 September 1967.

162. Red-necked Stint *E. ruficollis* (*). Selby saw several flocks on the flats in Adelaide Bay and one flock on the Pat's River aerodrome, almost beneath the wing of the 'plane while it "revved up" prior to take off. On my visit in September there were about 130 living on the gravel verges of the air strip and the adjacent tidal flats. None showed obvious breeding plumage. Forty were seen on the tidal flats at Patriarch Creek on 22 September 1967 and in excess of 100 were there on 27 November 1967.

163. Sharp-tailed Sandpiper *E. acuminata* (*). Seen by Selby on the flats in Adelaide Bay and again by the author on 26 November 1967. On the same day two were found feeding over the muddy edges of Brodies Lagoon. Also recorded by Mellor and White (1913).

168. Australian Snipe *Gallinago hardwickii* *. A few occur in the swampy areas. One was flushed several times in the swamps near Lackrana on my November 1966 visit.

187. White Egret *Egretta alba* *. One was seen on the edge of a small island in Cameron Inlet on 22 September 1967.

188. White-faced Heron *Ardea novaehollandiae* *B. Commonly seen in the vicinity of swamps, lagoons and tidal flats all round the coast. In 1965 and again in 1966 Rhodes found a number of nests.

191. Reef Heron *Egretta sacra* Le Souef (1902) records one pair from the Furneaux Group without giving the location.

197. Brown Bittern *Botaurus poiciloptilus* *B. Occasionally seen and heard in the tea-tree swamps and lagoons. The first breeding record was obtained in 1966 when a nest was found by Rhodes in a swamp on the south-east coast. I saw and heard several in this area during my visit in November 1966.

198. Cape Barren Goose *Cereopsis novaehollandiae* (*)B. Campbell (1894) describes it as "somewhat scarce" following a visit to the Furneaux Group in November 1893, the largest flock seen being of 30 on Anderson (= Woody) Island. It was rarely seen on Flinders Island prior to 1939 but bred up considerably during the war years (1939 - 1945) and has

continued to increase ever since. It is now possible, during the summer months, to see flocks totalling up to 500 birds grazing on clover pastures in the Lackrana area (D.M.R.) In such numbers the geese cause concern to the local farmers for, during the dry months, they are attracted to the green pastures, young crops and freshwater dams, resulting in crop damage and fouling of the water, making it unpalatable for domestic stock. On 26 November 1967 I counted about 200 geese which had congregated in a clover paddock on "Kanyana" at Lackrana. This problem is localised at present and farmers in most other parts of Flinders Island have no complaints of goose damage. It does not normally breed on Flinders Island but prefers the smaller offshore islands.

203. Black Swan *Cygnus atratus* *B. Plentiful wherever suitable water exists, particularly on the east coast, and it is a regular breeder. Rhodes does not consider it as numerous as 25 years ago. One swan banded at Moulting Lagoon, southern Tasmania, was subsequently shot on Flinders Island (Guiler 1966), a distance of about 180 miles north of the place of banding. This is not unusual as two black swans banded at Moulting Lagoon were subsequently recovered in New South Wales (Guiler 1966). This species was plentiful on Cameron Inlet on 21 September 1967 and two nests, one with five eggs and one with six eggs, were found in the rushes near the water's edge. Hundreds were present on both Cameron Inlet and Logan Lagoon on 27 November 1967.

207. Chestnut-breasted Shelduck *Tadorna tadornoides* *B. Dalgleish has recorded flocks of up to 42 at Memana and often sees pairs on his clover paddocks during the winter months. In October 1964 a clutch of about ten were reared on a water hole at "Dallen" and on 19 September 1967 a pair were present in the same locality. A few are usually present on most coastal inlets and lagoons.

208. Black Duck *Anas superciliosa* *B. Usually a common bird on inlets and lagoons but not so numerous as in previous years (D.M.R.) Half-grown young were seen on a tea-tree lined swamp near Loccota on 21 September 1967.

210. Chestnut Teal *A. castanea* *B. Usually present on lagoons and inlets but not so plentiful as in past years (D.M.R.) Several clutches of well developed young were seen on a tea-tree lined creek at Lackrana on 26 November 1967. One banded by the author near Longford, Tasmania on 10 March 1961 was shot near Cameron Inlet on 14 April 1961.

211. Grey Teal *A. gibberifrons* *. Usually present on the lagoons and inlets but in smaller numbers than in past years (D.M.R.) Frith (1962) records several recoveries of grey teal on Flinders Island, which had been banded in Tasmania and New South Wales.

212. Blue-wing Shoveler *A. rhynchotis* *. Rarely noticed on the island. A pair were seen on a small water hole near Loccota on 21 September 1967. Selby saw five near Whitemark.

213. Pink-eared Duck *Malacorhynchus membranaceus* (*). A single bird was shot on 9 March 1965, the skin of which is in the collections of the Queen Victoria Museum (reg. no. 1965/2/2).

215. Australian White-eyed Duck *Aythya australis* *. Several seen by Selby.

216. Blue-billed Duck *Oxyura australis* *B. A set of three eggs in the collections of the Queen Victoria Museum, found in a nest in rushes in a lagoon near Trousers Point about 1936, have been determined as of

this species by A. R. McEvey and N. Favaloro (pers. comm.)

217. Musk-duck *Biziura lobata* (*)B. Varies in numbers but can usually be seen on most lagoons and coastal bays. It has been recorded breeding at Trousers Point (J.B.N.) Dart observed 83 in Adelaide Bay on one occasion but states that about 20 is the more typical. They were present on most of the east coast lagoons during my visits in September and November 1967.

219. Swamp-harrier *Circus approximans* *B. A regular summer visitor. Odd birds may occasionally be seen during the winter months. Rhodes records the first annual appearance of south-bound birds about 26 August and north-bound birds mostly between 15 March and 20 March, usually in small parties of three to five. A few pairs breed in the swampland reed beds each summer. I saw seven individuals passing south over Memana on 20 September 1967 and two or three on most other days during that visit. It was regularly seen on the November visits.

221. Australian Goshawk *Accipiter fasciatus* *. Single birds were seen at Smith's Gully and Memana in March 1966. J. H. Calaby (pers. comm.) saw one on the summit of the Strzelecki Peaks on 23 March 1952. Selby saw two during his visit.

222. Collaret Sparrowhawk *A. cirrocephalus* (*)B. Seen on several occasions at Smith's Gully in March. Rhodes has found it nesting in the top of Cape Barren pines and Nield found a nest situated in bushy foliage at a height of about 70 feet in a gum tree on Mt. Strzelecki in September 1935.

224. Wedge tailed Eagle *Aquila audax* *B. Occasionally one or a pair are seen, usually in the vicinity of Mt. Strzelecki, where they have been known to breed for many years. Rhodes and Dalgleish, both progressive farmers, state that they have not known them to attack stock on the island. White (1909) records a pair and a deserted nest on top of the highest crag on Roydon Island, off the north-west coast. J. H. Calaby (pers. comm.) saw a pair on the summit of the Strzelecki Peaks on 23 March 1952.

226. White-breasted Sea-eagle *Halliaeetus leucogaster* *B. Fairly regularly seen in pairs or individuals and several nesting sites are known, mostly in lofty gum trees (D.M.R.) A pair were often seen in the vicinity of the lambing paddocks at "Dallen" in August 1964. They did not harass stock and were seen to feed only on carrion (A.D.) Two nesting sites were visited during my September visit, near Locotta and near Cameron Inlet. A sitting bird was present on each nest.

235. Little Falcon *Falco longipennis* (*). A pair were seen at close range by the roadside near Locotta in November 1966 and on 26 November 1967 another pair was found at Patriarch Creek. The latter pair appeared agitated by my presence and was apparently breeding in the vicinity. A single bird (reg. no. 1967/2/44) was collected near Lackrana on 26 November 1967 and was found to be feeding on a freshly caught sky lark. Its stomach also contained a quantity of flower wasps (*Thynnidae*), chafer beetles (*Scarabaeidae*) and dragon flies (*Odonata*). An adult male was shot on 5 November 1964, the skin of which is also lodged in the Queen Victoria Museum (reg. no. 1964/2/19). Its stomach was found to contain feathers, small bird bones and the remains of beetles and larvae. Rhodes is of the opinion that a pair breed on the slopes of Mt. Strzelecki. Two were seen during the R.A.O.U. campout in 1912 (Mellor and White 1913) one of which was collected and subsequently described as a new species *F. melanotus* (White and Mellor 1913). It is now regarded as synonymous with *F. longipennis*. J. H. Calaby (pers. comm.) saw one at Lady Barron on 20 March 1952.

237. Peregrine Falcon *F. peregrinus* Now rarely seen though once it was not uncommon. It used to breed in the Strzelecki ranges but is not believed to have done so in recent years (D.M.R.) A resident pair was observed on Babel Island from 13 to 15 March 1952 and a single bird was seen on the summit of Strzelecki Peaks on 23 March 1952 (pers. comm. J. H. Calaby).

239. Brown Hawk *F. berigora* (*)B. The most common hawk and it can regularly be seen in pairs and individuals throughout the island. In March 1966 about a dozen were continually hunting for common field crickets *Gryllus servillei* which were present in large numbers in a 20 acre paddock on "Dallen," Memana. The crop and stomach of a collected bird (reg. no. 1966/2/133) was found to be distended with the remains of these insects. Breeding records are numerous.

240. Nankeen Kestrel *F. cenchroides* (*)B. This species is rarely recorded as far south as Tasmania but a few appear to have always been present on Flinders Island. Up to three were regularly seen at Memana in March. J. W. Swift saw a single bird over Mt. Chappell Island in December 1966 which appeared to return to Flinders Island (pers. comm.) Cashion (1958) saw one on Cat Island. Several were seen on my September and November visits. They were first discovered breeding on Flinders Island in 1932 when a nest with young was found in the Strzelecki ranges. They have been found breeding on several occasions since then and sightings are not unusual (D.M.R.) It was once illegally shot by the farmers in the mistaken belief that it preyed on poultry, etc. but a campaign to enlighten the community about its protection and beneficial habits, conducted by those mentioned in the text, has resulted in it now being given complete protection. Dalgleish observed one during the winter of 1967 which was feeding on common field crickets. The hovering bird would suddenly drop to the ground, seize an insect in its claw and immediately take wing. The prey was then passed to its beak, eaten in flight and the performance repeated again.

241. Osprey *Pandion haliaetus* Le Souef (1902) records it from the Furneaux Group but gives no locality. Sharland (1958) states "occasionally a bird turns up on Flinders Island."

245. Spotted Owl *Ninox novaeseelandiae* (*)B. Seen and heard at Smith's Gully in March. The presence of one, roosting in a clump of thick tea-tree, was revealed by the continued alarm calls of many small passerines which congregated in the immediate vicinity about mid-morning. The species is generally considered to be not uncommon and Rhodes has found at least one occupied nest. The stomach of one (reg. no. 1966/2/61) was found to contain beetles and a large huntsman spider. It was heard calling at Memana and Lackrana in September 1966.

253. Sooty Owl *Tyto tenebricosa* A single bird was seen in daylight by Selby just north of the Pat's River aerodrome. Rhodes and others are of the opinion that this species lives and breeds on Flinders Island. Sharland (1958) records it from Flinders Island. It does not occur in Tasmania.

258. Musk-lorikeet *Glossopsitta concinna* Le Souef (1902) records it from the Furneaux Group but gives no locality.

267. Yellow-tailed Black Cockatoo *Calyptorhynchus funereus* *B. Flocks of up to fifty have been seen in the past but Dart and others consider it is no longer so numerous, a result of the large land clearing operations. The species has been known to breed on Flinders Island in the hollow trunks of dead gum trees (D.M.R.), Sharland (1958). About 30 years ago Nield found a nest at a height of about 30 feet in the barrel of a dead

tree standing in the school grounds at Altmoor. Several small flocks were seen during my visits.

273. Galah *Kakatoe roseicapilla* A single bird lived in the vicinity of Emita for several years about 1950 (D.M.R.)

285. Green Rosella *Platycercus caledonicus* (*)B. Widely distributed over the island and plentiful in most habitat types. Rhodes and Nield state that the species is a regular local breeder and that nests have been found in the hollow limbs of gum trees in the Strzelecki ranges.

309. Swift Parrot *Lathamus discolor* *. Birds answering the description of this species have been noticed occasionally by Rhodes and Dalgleish who believe it to breed on the island. "Fair numbers" were seen during the R.A.O.U. campout from 20 - 28 November 1912 (Mellor and White 1913).

311. Ground-parrot *Pezoporus wallicus* Campbell (1891) records it from the Kent Group. Gould procured a specimen on Flinders Island (White and Mellor 1913). I was unable to find any evidence of its continuing occurrence.

313. Tawny Frogmouth *Podargus strigoides* Selby listed one on his visit.

317. Owlet-nightjar *Aegotheles cristata* Selby listed "one flushed from hole" on the occasion of his visit.

322. Laughing Kookaburra *Dacelo gigas* (*)B. A few were introduced in the centre of the island about 1940. They have since bred up and spread but have not yet reached the extreme north or south.

334. Spine-tailed Swift *Hirundapus caudacutus* *. Migrating birds are seen flying northwards each autumn, usually for a period of two or three days at a time (D.M.R.)

337. Pallid Cuckoo *Cuculus pallidus* *B. Absent during the winter months but returns to the island each spring and is commonly seen and heard during the breeding season.

338. Fan-tailed Cuckoo *Cacomantis pyrrhophanus* *B. Absent during the winter months but commonly seen and heard during the summer. A flying juvenile was seen in November 1966 and eggs have been found by Rhodes in domed nests of small passerines.

342. Horsfield Bronze-cuckoo *Chalcites basalis* (*)B. An adult male was collected on 14 November 1966 (reg. no. 1966/2/167) and a few other individuals were seen. Selby saw one in November 1952. Two were seen at Pat's River on 23 September 1967. It is absent in the winter months.

344. Golden Bronze-cuckoo *C. plagosus* *B. Odd individuals were seen on the September and November visits and Selby saw one on his visit. Rhodes has seen an egg of this cuckoo in a nest of the brown scrub-wren.

357. Welcome Swallow *Hirundo neoxena* *B. Common during the summer months and breeding pairs can be found round most homesteads where it fixes its mud nests beneath bridges, verandahs, eaves and other such sites in hay barns, sheep sheds, etc. Away from settlements, it nests beneath the sheltered ledges on rocky cliff faces or in the burnt-out trunks of trees. At the time of our visit in March most had left

the island, the only ones seen being a pair at Whitemark. Individuals and odd pairs are rarely seen in the winter months.

359. Australian Tree-martin *Hylochelidon nigricans* *B. A regular summer visitor, common and widely distributed. It is absent in the winter months and none were seen during our visit in March 1966. Mollison (1960) saw many birds migrating northwards over the sea between Flinders and Cape Barren Island on 26 February 1958 and Cashion (1958) saw six on 3 March, apparently on migration.

360. Fairy Martin *H. ariel* Le Souef (1902) records it from the Furneaux Group but gives no locality.

361. Grey Fantail *Rhipidura fuliginosa* (*)B. A common species throughout the year. In the areas of scrub, especially the gullies, it is most conspicuous during the summer months. It was very plentiful during all my visits.

364. Willie Wagtail *R. leucophrys* *. Rhodes recollects seeing a single bird at Emita about 1950 and another at Lackrana in the summer of 1963-64. Dalgleish knew of one at Memana for a few weeks in August 1965 and Selby saw one at Whitemark.

365. Leaden Flycatcher *Myiagra rubecula* Le Souef (1902) records it from the Furneaux Group but gives no locality.

366. Satin Flycatcher *M. cyanoleuca* *. One female was seen at Smith's Gully on our March visit.

380. Scarlet Robin *Petroica multicolor* (*)B. Common throughout the year and a regular breeder (D.M.R.) It was particularly noticeable during our visit in March. At Smith's Gully dozens were about the clover paddocks bordering the bush, in company with flame robins. At Memana they were just as plentiful and were conspicuous over the recently burnt hill country, the red of their breasts contrasting against the blackened background.

382. Flame Robin *P. phoenicea* (*)B. Common throughout the island and most conspicuous in the clover paddocks bordering the bushland during our visit in March. At Smith's Gully dozens could be seen perched about the paddocks on dead thistles, fences, sticks and anywhere which afforded a "look out" point in their search for insects. At Memana they were commonly found on the recently burnt hillsides as well as the adjoining pasture paddocks. Dozens were seen in the pasture paddocks at Memana during my September visit and a nest with three eggs, was found seven feet up in dead tea-tree at Brodies Lagoon on 26 November 1967. Rhodes has found them nesting on ledges, rafters, etc. in sheds as well as the more normal broken stump or limb. Like the welcome swallow, they have readily adapted to the man-made environment. They are not common in the winter months (D.M.R.) This was the most common robin seen by Selby in November 1952.

383. Pink Robin *P. rodinogaster* (*)B. A few occur in the upper reaches of some deep, densely vegetated gullies in the Strzelecki ranges where it has been found breeding (D.M.R.) Gabriel (1896) found it on the slopes of Strzelecki at an altitude of 1,500 feet.

386. Dusky Robin *P. vittata* (*)B. Common and widespread throughout the island. Rhodes has found nests as early as 14 August. It was plentiful at both Smith's Gully and Memana in March.

398. Golden Whistler *Pachycephala pectoralis* (*)B. Occurs in wooded gullies and scrub country. Pairs and individuals were often seen and heard at both Smith's Gully and Memana in the bushland and tea-tree scrubs. Rhodes has found it breeding on numerous occasions.

405. Olive Whistler *P. olivacea* (*)B. Common in the tea-tree and scrub country, pairs and individuals being seen and heard in many areas during all visits. Selby found a nest with eggs.

408. Grey Shrike-thrush *Colluricincla harmonica* (*)B. Common throughout the island at all times of the year particularly in the light scrub and open bush country. In March at Smith's Gully they were found to have been feeding principally on grasshoppers which were plentiful at that time.

415. Magpie Lark *Grallina cyanoleuca* *. Rarely recorded. Selby saw a pair at Lady Barron perched on overhead wires. Rhodes saw one at Memana in 1964 and another in the same year living round a water hole at Lackrana. Dalgleish saw one at Memana in August 1965.

424. Black-faced Cuckoo-shrike *Coracina novaehollandiae* *B. A few are present during the summer months when it breeds in the eucalypt country, but absent in the winter. None were seen during our visit in March, but odd individuals were seen in September and November.

447. Australian Ground-thrush *Oreocincla lunulata* (*)B. A few in the dense scrubby gullies in the Strzelecki ranges and occasionally seen in the thick tea-tree scrubs on the lowlands. A pair were seen beneath dense canopy in a creek at Smith's Gully in March and one (reg. no. 1966/2/75) was found to have been feeding on wire worms and wood boring larvae. In November 1964 Rhodes found a five foot six inch tiger snake *Notechis ater* in the act of swallowing one of two half-grown nestlings. The snake had climbed up through the dense, slightly leaning tea-tree scrub to a height of ten feet to reach the nest. Mattingley (1938) found it on Deal Island in the Kent Group.

448. White-fronted Chat *Epthianura albifrons* (*)B. Common and widespread but showing a preference for the edges of open swamp lands, waterlogged areas, or along the banks of creeks and drains. Small flocks were a common sight at Memana on both visits and in March they were often seen working over the edge of the freshly burnt ground adjoining the clover paddocks. Rhodes has found nests as early as August and a nest with three half-grown young was found by the roadside at Lackrana on 23 September 1967. They often breed in the coarse grasses on small offshore islands.

473. Tasmanian Thornbill *Acanthiza ewingii* (*)B. A number of thornbills were collected at Smith's Gully, Memana and Lackrana, all of which were found to be of this species. Juveniles just out of the nest and being tended by adults were seen on several occasions during the September visit. A nest composed of fine strips of tea-tree bark and containing an addled egg was found at a height of two feet in a small dense bush growing in an open swamp at Memana on 19 September 1967. It is a very common bird throughout the island occurring in all types of scrub and bushland habitat from the coast to the uppermost reaches of the gullies in the Strzelecki range. As a result of these observations I believe that this is the only *Acanthiza* species on the island. Mellor and White (1913), referring to *A. ewingii*, state "Flinders Island abounds with this Tit" but later White (1913) after some confusion considered the birds in question were *A. diemenensia* (= *A. pusilla*). Mack (1936) records *A. ewingii* as being the only *Acanthiza* species on Flinders

Plate 1. Bob Smith's Gully in the foothills of the Strzelecki ranges and the camp site from 14 - 22 March 1966.

Plate 2. "Dallen," the no. 1 block of the Memana settlement which was the camp site from 22 - 25 March 1966 and other subsequent occasions.

Plate 3. One of the lagoons in the south-east of Flinders Island. The extensive fires in March 1966 devasted most of the dense tea-tree and scrub which surrounded this and other lagoons in the area.

Plate 4. Habitat of the tawny-crowned honeyeater near Locotta in a coastal strip between the Strzelecki Peaks and the south coast.

Island. In Tasmania it appears to be confined to the rain forests and wet gullies, rarely if ever occurring on the dry hillsides, this latter habitat being occupied by its near relative the brown thornbill (*A. pusilla*). On Flinders Island *A. ewingii* is far less restricted and occurs in typical *A. pusilla* habitat as well as in the wet gullies. Selby found an occupied nest which was of *A. ewingii* type placed about two feet above the ground but the activity of the birds rendered identification doubtful.

475. Brown Thornbill *A. pusilla* Littler (1913) considers this species occurs on Flinders Island and White (1913) includes it when he changes his opinion previously expressed (Mellor and White 1913). I consider these determinations to be erroneous and that the species in question is in fact *A. ewingii* (see 473).

487. Scrub Tit *Acanthornis magnus* Le Souef (1902) records scrub tit *Sericornis magna* from the Furneaux Group in 1901 but fails to give the locality. It may occur in the upper reaches of the dense relict rainforest gullies on the Strzelecki ranges but despite some searching I was unable to locate it.

495. Brown Scrub-wren *Sericornis humilis* (*)B. Because of the complexity of speciation in the genus *Sericornis* and in conformity with the opinions of Campbell (1935) and Mayr (1937), I have tentatively included the Flinders Island race within this species. It was found to be a common bird throughout the whole island wherever thick vegetational cover exists. A sample collected from Smith's Gully, Memana and Lackrana was examined by Mr. A. R. McEvey, Curator of Birds at the National Museum of Victoria who considered them to be fairly typical of the Victorian *S. frontalis*. Later collecting in northern Tasmania has produced a number of specimens which are likewise similar to the Victorian and Flinders Island birds. Sub-adults collected at Lackrana in November 1966 were mostly more brownish and lacking of the white eyebrow as are the sub-adults in Tasmania. These were possibly several months old, as flying young still tended by adults were numerous during the September visit. The Tasmanian and Flinders Island birds were found to be considerably larger and heavier than those from Victoria. Though the sample is small and many of the *S. frontalis* skins lack the necessary data for good comparisons, the figures given in the accompanying table (mean in brackets) indicates a size gradient from the large Tasmanian race to its smaller Victorian near relative. The size difference between Tasmanian and Flinders Island birds is less significant and supports the inclusion of the Flinders Island race within the species *S. humilis*.

LOCALITY		WEIGHT (gm)	TOTAL LENGTH (mm)	WING SPAN (mm)
Tasmania	11	14.5 - 20 (18.2)	126 - 145 (134.5)	173 - 195 (184.5)
Flinders Is.	13	14.5 - 19 (17.1)	130 - 148 (133.7)	160 - 196 (177.5)
Victoria	6	12.5 - 20 (14.2)	115 - 130 (121.7)	130 - 161 (143.5)

Campbell (1901) recorded it from the Furneaux Group and Littler (1910) also lists it from the Kent Group. White and Mellor (1913) described it as a new species *S. flindersi*. Ridpath and Moreau (1966) discuss its affinities to *S. frontalis* and Ridpath reports having seen "birds which appear to be of both species close together."

Mayr (1937) groups *S. humilis* with *S. maculatus*, *S. frontalis* and *S. baccarii* in a widely ranging superspecies *S. frontalis*. He gives the

range of *S. humilis* as Tasmania and the islands of Bass Strait and states "This species is clearly a representative of *frontalis*, with which it is connected by the various races on the islands of Bass Strait and southern Victoria." The present data indicates a size gradation across Bass Strait and that plumage variations occur mainly as a result of aging and sex.

500. Striated Field-wren *Calamanthus fuliginosus* Le Souef (1902) listed it from the Furneaux Group without giving any location.

522. Little Grassbird *Megalurus gramineus* (*). The distinctive call of this species was heard in the thickly growing reeds of two lagoons on the east coast in November 1966. White (1909) found it near Killiecrankie and it was seen and collected during the R.A.O.U. campout in 1912 (Mellor and White 1913) and subsequently described by White and Mellor (1913) as a new species but this is now considered synonymous. White (1909) and Cashion (1958) found it on Cat Island and the Queen Victoria Museum holds two specimens (reg. no. 1968/2/210 - 211) collected on Tin Kettle Island.

524. Reed Warbler *Acrocephalus australis* Le Souef (1902) lists it from the Furneaux Group without giving the locality.

526. Southern Emu-wren *Stipiturus malachurus* Le Souef (1902) lists it from the Furneaux Group without giving the location.

529. Superb Blue Wren *Malurus cyaneus* (*)B. Common throughout the island at all times of the year and occurring in all habitats from the coast to high in the Strzelecki ranges. A pair were found feeding a flying young cuckoo (*Chalcites* sp.) at Locotta on 23 November 1967.

547. Dusky Wood-swallow *Artamus cyanopterus* *. None were seen during our visit in March but odd individuals were there in November 1966 and November 1967. Rhodes does not recall ever finding them breeding on Flinders Island and considers that they occur only as passing migrants. Selby saw four pairs in November 1952. Dalgleish saw a migrating flock of about 50 at Memana on 20 April 1966 and others at Palana about the same time. Approximately 100 were present in the vicinity of "Dallen," Memana during the week following 1 May 1968. None were seen during my September visit but on 17 September several dozen apparently newly arrived migrants were seen at Exeter in northern Tasmania.

565. Spotted Pardalote *Pardalotus punctatus* *B. Not observed during our visit of March but in November 1966 I found a pair feeding flying young, and a brooding bird tending a nest in a hole in a sandy roadside cutting near Locotta. They can occasionally be heard calling in the eucalypts but do not appear to be a common species. Selby saw only three.

567. Striated Pardalote *P. striatus* (*)B. Not observed during our March visit but a number were seen and heard on the November visits when I found several occupied nesting in tree cavities and in road cuttings near Lackrana.

571. Forty-spotted Pardalote *P. quadragintus* Le Souef (1902) recorded it from the Furneaux Group but gives no locality. Campbell (1903) also records it from King Island.

574. Grey-breasted Silvereye *Zosterops lateralis* (*)B. Very numerous during our March visit when flocks in excess of a hundred were seen

regularly feeding on the green fruit of tea-trees growing along the creek in Smith's Gully. They were continually on the move and appeared to be passing through on migration. The species is found all over the island, many remaining throughout the winter.

578. White-naped Honeyeater *Malithreptus lunatus* Campbell (1891) lists it from the Kent Group and White (1909) records it also on Deal Island. However, it is suggested that these authors may have mistakenly determined the somewhat similar *M. validirostris* or *M. affinis* for this species.

582. Strong-billed Honeyeater *M. validirostris* (*)B. A few were present in the tall eucalypts growing on the slopes of Smith's Gully during the March visit and were calling almost continually as they fed amongst the upper foliage. A few were also seen at Lackrana in November 1966 and Cameron Inlet in September 1967. White climbed to a nest situated high up in thick eucalypt foliage during the R.A.O.U. campout of 1912 (Mellor and White 1913) and found it contained two almost naked young.

584. Black-headed Honeyeater *M. affinis* (*)B. Not seen at Smith's Gully or Memana in March but a few were seen at Lackrana on both November visits. They were continually on the move in the upper foliage of the eucalypts and gave every indication of tending nests. During the September visit they were not uncommon at Memana, Locotta and Cameron Inlet. Selby saw several on his visit.

591. Eastern Spine-bill *Acanthorhynchus tenuirostris* (*)B. Rhodes considers that this species is now much rarer than previously. It is widely distributed but is seen only occasionally. It was described as scarce in 1912 by Mellor and White (1913). One (reg. no. 1966/2/121) was collected at Memana in March and several were seen at Killiecrankie on 22 September 1967. Salomonsen (1966) considers that Flinders Island is probably included in the range of his King Island subspecies *A. t. regius* which he separates from all other subspecies on "the very long bill, measuring 32 mm, with a wing of 71 mm." The measurements were taken from a subadult male in the collections of the American Museum of Natural History (reg. no. 693497). The Flinders Island specimen (reg. no. 1966/2/121) is an adult female with a bill length (measured to the base of the skull) of 25 mm, tarsus of 19 mm and wing of 59 mm. These measurements are nearly similar to those of the Tasmanian population.

593. Tawny-crowned Honeyeater *Gliciphila melanops* (*)B. I searched for this bird on both the 1966 visits but failed to see it. On my September visit I found it near Locotta (see plate 4) and at Killiecrankie. In both localities it was living in a rather specialised habitat, the most prominent feature of which was the grasstree (*Xanthorrhoea australis*). Stunted cabbage gums (possibly *Eucalyptus pauciflora*) and honeysuckle (*Banksia marginata*) were scattered throughout the area. A sample of the vegetation was collected from the Killiecrankie area and lodged in the Queen Victoria Museum. It also includes manuka tea-tree (*Leptospermum scoparium*), purple bottle-brush (*Myrtaceae squamea*), spreading wattle (*Acacia diffusa*), common heath (*Epacris impressa*), twiggy bearded heath (*Leucopogon virgatus*), clusted guinea flower (*Hibbertia fasciculata*) and a fine rapier sedge which was not determined. Only odd tawny-crowned honeyeaters were seen and heard in the Locotta area but near Killiecrankie the species was very conspicuous and vocal. On occasions upwards of a dozen could be seen flying above the vegetation and sometimes rose to a height of several hundred feet as they passed overhead. Two males were collected (reg. nos. 1967/2/21 - 22). Their testes were enlarged to 7 mm by 5 mm but

no nests were located. Much of this habitat is periodically burnt and in consequence it is then not suitable for occupancy by these birds for some years. Both areas where it was found are destined for pastoral development in the near future but there are other areas with little agricultural potential which could support good populations if the firing could be controlled. It occurs on adjacent Cape Barren Island (pers. comm. Jim Napier) and Selby saw several some distance north of Pat's River airport. A "fair number" were seen on the R.A.O.U. campout in 1912 and "found in swampy country" (Mellor and White 1913). Mattingley (1938) found it on Deal Island in the Kent Group.

616. Yellow-throated Honeyeater *Meliphaga flavicollis* (*)B. Common throughout the island in a wide variety of habitat. It was regularly seen at Smith's Gully and on the recently burnt hillsides at Memana in March.

630. Crescent Honeyeater *Phylidonyris pyrrhoptera* (*)B. Widely distributed but nowhere common.

631. Yellow-winged Honeyeater *P. novaehollandiae* (*)B. Common in a wide range of habitat types. It was regularly seen on the recently burnt hillsides at Memana in March. Subadults were common at Smith's Gully in the same month. It was considered "thinly distributed over the island" in 1912 (Mellor and White 1913). Salomonsen (1966) regards the Bass Strait population as subspecifically distinct.

637. Little Wattle Bird *Anthochaera chrysoptera* Le Souef (1902) lists it from the Furneaux Group but gives no locality.

639. Yellow Wattle Bird *A. paradoxa* Le Souef (1902) lists it from the Furneaux Group but gives no locality.

647. Australian Pipit *Anthus australis* *B. Occurs in most agricultural and grazing areas though nowhere in large numbers. In March a pair were seen at Smith's Gully in a fallowed paddock and in November 1966 at Lackrana several pairs were found in clover paddocks bordering light scrubland. Mellor and White (1913) considered it to be thinly distributed over the island in 1912. Its present numbers are now greatly exceeded by the introduced skylark which has apparently benefited from pastoral development.

650. Beautiful Firetail *Zonaeginthus bellus* (*)B. A few small parties were seen at Smith's Gully and Memana in March and other observers have seen them in various other localities. At Smith's Gully they were regularly seen feeding on the ground in clover paddocks bordering a densely forested creek and, when disturbed, sought shelter in that cover. Rhodes considers they are now rarer than in past years and states that they nest mostly in the she-oak trees (*Casuarina* sp.) He has noticed a high rate of infertility in their eggs, with usually one and sometimes more being left addled in the nests.

690. Raven *Corvus mellori* *B. This is the only *Corvus* species so far determined from Flinders Island and Tasmania (pers. comm. Ian Rowley). It occurs commonly all over the island. Small parties were seen on the Memana paddocks in March and appeared to be feeding on pasture parasites. Rhodes has seen many occupied nests usually in eucalypts growing in forest country.

696. Black Currawong *Strepera fuliginosa* (*)B. Fairly common and widespread. They nest in tall trees in the eucalypt forests but are often seen feeding in the open grazing country. One (reg. no. 1966/2/36)

collected at Smith's Gully in March was found to have been feeding on grasshoppers which were very numerous at that time. Four were seen in the Whitemark township on 23 September 1966.

699. Clinking Currawong *S. arguta* Recorded as not numerous by White and Mellor (1913).

702. Grey Butcher-bird *Craticus torquatus* Le Souef (1902) lists it from the Furneaux Group but gives no locality.

707. White-backed Magpie *Gymnorhina hypoleuca* *B. An introduced species, liberated at Emita about 1940 and now gradually increasing in numbers and distribution, though still very localised. A few have been released at Memana in recent years and appear to be becoming established. A pair nested in a tall eucalypt near the Memana-Whitemark road in 1965 (A.D.) Robinson (Plomley 1966) records "an abundance of Magpies" on Anderson (= Woody) Island on 10 November 1830 but the possibility that he was referring to *S. fuliginosa* (sometimes called "black magpie") must not be overlooked.

INTRODUCED FOREIGN SPECIES

991. Black-bird *Turdus merula* (*)B. Introduced on the island about 1930: the first evidence of breeding was a nest found at Locotta in 1932 (D.M.R.) It multiplied rapidly and is now common and widespread. Areas of tea-tree swamp are greatly favoured and it appears well adapted to this natural environment, which in many instances is still relatively unaffected by the influence of human settlement. Selby found it very common in 1952. Mattingley (1938) found several on Deal and Hogan Island in 1938.

993. Skylark *Alauda arvensis* (*)B. The date and locality of introduction appears unknown but it was first noticed by Rhodes in the vicinity of Happy Valley, between Whitemark and Locotta, about 1928. It is now very numerous throughout the agricultural areas and, on the expansive newly developed pastures at Memana, it has greatly increased its numbers with the spread of cultivation. It was very spectacular on all my visits. Despite extensive searching no nests could be found and a sample collected in November 1966 revealed that they were then some time off laying, testes of the males being approximately 1 x 1 mm and ovaries of the females about 0.2 mm in diameter. Display flights and singing were being vigorously carried on and it was possible to see dozens of individuals in the air and on the ground at any time of the day. Distribution in not confined to the improved pastures as many birds were found resting in recently burnt scrub land bordering the clover paddocks.

995. House Sparrow *Passer domesticus* *B. This introduced species has been common for many years. I have been unable to ascertain the date of its introduction but it has probably been present since early settlement. It is rarely, if ever, seen in unaltered bushland but prefers to remain in and around the townships and farm homesteads where small flocks are a regular sight. Two were found on Deal Island in the Kent Group in 1890 (Le Souef 1891). Cashion (1958) found it on Cat Island.

996. Goldfinch *Carduelis carduelis* (*)B. Common and fairly widespread for many years. It appears to benefit from land clearing and settlement and shows a preference for agricultural areas. Land development for farming purposes appears to result in an increase of its numbers.

997. Greenfinch *Chloris chloris* *B. First recorded by McGill and Wheeler

in 1948 (Tarr 1950). Rhodes first noticed it in the Locotta area in 1953 and it is now not uncommon in that locality.

999. Starling *Sturnus vulgaris* *B. Very numerous throughout the island for many years. Flocks of many hundreds are often seen in the pastoral areas.

Pheasant *Phasianus colchicus* var. *B. Pheasant have been liberated at various places throughout the island over the last ten years and appear to be breeding.

OTHER LAND VERTEBRATES

Le Souef (1929) gives an annotated list of the mammals from some of the islands of eastern Bass Strait and it is interesting to compare his remarks on populations with the present situation. It is apparent that the rapid depletion of the fauna to which he refers has not continued as most species today are numerically strong. It seems probable that the introduction of large dogs to the Bass Strait islands could have affected drastically the mammal fauna in the early nineteenth century. Robinson (Plomley 1966) found dogs in considerable numbers in 1830, apparently introduced by the sealers and spread by the natives. Robinson estimated at least 200 on the islands between Flinders and Cape Barren Island and states that "most of the islands are infested with wild dogs." None occur in a feral state today.

Spiny Ant-eater *Tachyglossus setosus*. Not uncommon throughout the island and occurring in a variety of shades of colour from cream to deep brown. One cream animal (reg. no. 1966/1/16) was collected at "Dallen," Memana in March.

Red-necked Wallaby *Wallabia rufogrisea*. Very plentiful throughout the bushlands, causing some damage in agricultural areas where it grazes on crops and pastures bordering its diurnal retreats. Despite the effects of land clearing, fires and the snaring of animals for the fur market in the past years (Le Souef 1929), it remains abundant.

Pademelon *Thylogale billardieri*. Common throughout the thick scrubby areas, invading agricultural land like the preceding species. This animal and *W. rufogrisea* are now used by some commercial fishermen as bait in crayfish pots.

Potoroo *Potorous tridactylus*. Very rare. Rhodes has seen only two in about thirty years of observations, though he has seen tracks on several occasions. Mr. Ralph Morton Snr flushed one at Settlement Point in 1965 (pers. comm. D. L. Serventy). A decayed carcase was found following the extensive fires of 1966 (pers. comm. J. Hope). The Australian Museum holds a specimen (no. M4398) collected at Lady Barron in September 1928 and it is assumed that this is the specimen referred to, with dimensions, by Le Souef (1929).

Wombat *Vombatus ursinus*. Le Souef (1929) "presumed that the last of them had gone" following enquiries he made in 1928 and it appears to have been very rare about that time. It is now common throughout the bushlands where it burrows extensively in the light sandy soil. Dense clumps of tea-tree adjoining improved pastures are a favourite habitat.

Brush-tail Possum *Trichosurus vulpecula*. The grey colour phase, similar to those of the Tasmanian midlands and north-east, is common in the bushland and agricultural areas but the black phase, which is dominant in western and southern Tasmania, does not occur on the island. Old

"reds" and "reddish greys" appear more common in areas close to the coast (D.M.R.)

Tasmanian Ring-tail *Pseudocheirus convolutor*. Not uncommon throughout the island, often seen and heard calling in the tea-trees round the camp at Smith's Gully. Le Souef (1929) obtained two males and a female and from these described a subspecies *P. c. bassianus* (holotype male Aust. Mus. no. M4450; allotype female Aust. Mus. no. M4449). Troughton (1965) supports this subspecific rank.

Pigmy Possum *Cercartetus nanus*. An adult female in a torpid condition was found in a Launceston woolstore on 6 May 1965 inside a bag of wool which had just been received into the store from Flinders Island. It is now in the spirit collection of the Queen Victoria Museum (reg. no. 1966/1/20). Rhodes has found them on several occasions, usually in a cavity in the decaying stump of a grass tree.

Short-nosed Bandicoot *Isoodon obesulus*. Le Souef (1929) obtained two skins with skulls (Aust. Mus. nos. M4451 - 4452) from West Sisters Island and gives dimensions. The species still survives there today and is often seen at dusk in the vicinity of introduced boxthorn bushes beneath which it appears to hide during the day time (pers. comm. John Whinray). We were unable to find evidence of any bandicoots occurring on Flinders Island, though J. A. Kershaw's unpublished field notes mention seeing signs of bandicoots near Killiecrankie on 12 January 1909. These diggings were more probably made by ant-eaters, as residents of many years have never found bandicoots on Flinders Island.

Tiger Cat *Dasyurops maculatus*. Gabriel (1894) includes it in a short list of mammals encountered in the Furneaux Group in November 1893.

Quoll *Dasyurus viverrinus*. Le Souef (1929) states "are reported as still being seen on Flinders and Barren Island." There are no recent reports of its presence.

Little Marsupial-mouse *Antechinus minimus*. A very large male (reg. no. 1961/1/12) was sent to the Queen Victoria Museum from the Blue Rocks area in June 1961. I saw a large *Antechinus* sp. crossing a bush track in dense tea-tree scrub near "Dallen," Memana at dusk on 23 March 1966. A subadult male (body weight 19.5 gm, reg. no. 1967/1/52) was captured at Locotta on 25 November 1967. Le Souef (1929) obtained a single specimen (Aust. Mus. no. M4342) from Clarke Island.

Yellow-footed Pouched-mouse *A. flavipes*. Le Souef (1929) records a specimen (*Phascogale flavipes flavipes*, Aust. Mus. no. M4459) collected from West Sisters Island in November 1928. This specimen was incorrectly determined and is in fact *Sminthopsis murina*.

White-footed Pouched-mouse *Sminthopsis murina*. Le Souef (1929) records one from Clarke Island (Aust. Mus. no. M4343) and in addition the Australian Museum holds two skins and skulls, no. M4459 referred to above and no. M4584, collected by A. S. Le Souef on 12 April 1929 also from West Sisters Island. This latter skin is, however, not consistent with examples of the Tasmanian race and suggests the possibility of an island subspecies. An animal, resembling this species, was recently found nesting in the pocket of an old coat hanging in a shed on West Sisters Island (D.M.R.)

Grey-headed Fruit-bat *Pteropus poliocephalus*. One was found feeding on a bag of apples in a shed on Babel Island off the east coast of

Flinders Island at Easter 1955 and is now in the collections of the Tasmanian Museum, Hobart (Sharland 1962). Nield found one at night on the beach of Dog Island during the muttonbird season in April 1958. It had been attracted by discarded apples and was captured by hand and subsequently released. It returned again the following night, was recaptured and sent to a private zoo in southern Tasmania.

Little Brown Bat *Eptesicus pumilus*. The Queen Victoria Museum holds a spirit specimen (reg. no. 1959/1/4) collected at Emita on 12 November 1947. A few small bats are seen at various times (D.M.R.)

Lesser Long-eared Bat *Nyctophilus geoffroyi*. Stephen Rhodes collected an adult female (reg. no. 1968/1/19) near Whitemark on 11 March 1968. John Whinray collected an adult male (reg. no. 1968/1/28) in an old house on West Sisters Island on 5 February 1968.

Eastern Water-rat *Hydromys chrysogaster*. Not uncommon in the drainage systems and round the coastline. Nield found them occasionally to kill and eat domestic fowls.

Eastern Swamp-rat *Rattus lutreolus*. Two males, with testes enlarged to 21 x 13 mm, were trapped in a dense tea-tree swamp near "Dallen," Memana in September 1967. They have been spirit preserved in the Queen Victoria Museum collections (reg. nos. 1967/1/39 and 1967/1/40). A female (reg. no. 1967/1/53) was trapped at Locotta on 24 November 1967. Its nipple complement of T2 + I2 = 8 was in confirmity with that of the Tasmanian subspecies *R. l. velutinus*. Several were collected by J. Hope in 1966 (pers. comm.) and Rhodes collected an adult female (reg. no. 1967/1/55) on 28 November 1967 during land clearing operations at Locotta.

INTRODUCED FOREIGN MAMMALS

Ship Rat *Rattus rattus*. This introduced species fluctuates throughout the island. It was common in the tea-tree scrub at Smith's Gully in March and a subadult female (reg. no. 1966/1/15) was trapped. It was plentiful at Lackrana in September 1967 and ten were trapped in 60 trap nights. They were all adult but none of the six females appeared pregnant or to be suckling young. The testes of the males were large (to 21 x 11 mm). Blacks, greys with grey bellies and greys with cream bellies were included in the bulk sample which was retained for the collections of the Queen Victoria Museum (reg. no. 1967/1/41).

European House Mouse *Mus musculus*. Introduced with early settlement and now common throughout the island. Several were trapped in the dense tea-tree scrub at Smith's Gully and in a hay barn at Memana during our March visit. Baled grass hay stacked in the open paddocks was infested with mice. This was apparently the attraction for nankeen kestrels and brown hawks which were often seen in the vicinity of these stacks. In September one was trapped in a thick tea-tree swamp from which velvet-furred rats were trapped.

Rabbit *Oryctolagus cuniculus*. The unpublished notes of J. Kershaw record rabbits on Edith Island in the Kent Group in 1909. Despite rigid laws which prohibit the introduction of rabbits, a number have been found on Flinders Island over the past 15 years. The first sighting was of a single rabbit about five miles north-east of Emita on 31 July 1952. Others were subsequently seen in the area but it is believed that this introduction was of castrated bucks only. They appear to have been successfully eradicated as none have been seen since 1955. Another introduction was reported at Costers Road,

Lady Barron in November 1963 and 15 were killed in the area between 8 and 19 November. In March 1965 more were found about a mile north and in October 1965 one was shot on "Wallanippi" near Smith's Gully. In June 1966 two were brought in by air from New South Wales but these were confiscated and destroyed before release. Following every reported occurrence the Tasmanian Department of Agriculture and local residents have made determined efforts to eradicate the rabbits by the use of traps, dogs, guns, myxomatosis and extensive poisoning and as a result 49 have been known to have been killed. It now appears that their efforts have been successful as no evidence can be found to indicate that any rabbits remain on Flinders Island (pers. comm. C. E. Holmyard, Senior Vermin Inspector, Department of Agriculture).

Hare *Lepus europeus*. Introduced to and established on the West Sisters Island for some years (D.M.R.)

Feral Cat *Felis catus*. Occurs throughout the island but is now less common than in previous years (D.M.R.)

Feral Pig *Sus scrofa*. Common in the Strzelecki ranges and other bushlands. Though not seen at Smith's Gully in March 1966 there were extensive areas of freshly uprooted ground as evidence of its presence in the adjacent scrub. Several young ones were seen in the upper reaches of a dense gully above Locotta in November 1967.

AMPHIBIA

An account of the amphibia of Flinders Island is given by Littlejohn and Martin (1965). In the course of our visits in 1966 we recorded all and only those six species accredited by them to the island.

Spotted Marsh-frog *Limnodynastes tasmaniensis*. Heard calling from the swamps in numerous localities on each visit. In September it was calling vigorously and laying in many swampy areas. A few were collected (reg. no. 1967/4/6).

Burrowing Marsh-frog *L. dorsalis*. Heard calling from the swamps in numerous localities on each visit. It was calling vigorously during my September visit and was just commencing to lay. One was collected (reg. no. 1967/4/4).

Brown Froglet *Crinia signifera*. Heard calling and collected at Memana (reg. no. 1967/4/3) in March. A few were calling at various localities in November 1966. It was calling vigorously in September and a sample (reg. no. 1967/4/8) was collected.

Smooth Froglet *C. laevis*. MacKay (1955) includes this species in the herptofauna of Flinders Island, but Littlejohn and Martin (1965) express the opinion that the single specimen in question was erroneously determined and was in fact *C. signifera*.

Brown Tree-frog *Hyla ewingi*. Heard calling in many localities in March and a few collected (reg. no. 1967/4/1). A few were calling at Lackrana in September and November.

Green and Golden Tree-frog *H. aurea*. The remains of several which appeared to have been half eaten by birds were found at "Dallen," Memana in March. Many were calling from the swamps at Lackrana in November. On my September visit a few were heard calling.

Toadlet *Pseudophryne semimarmorata*. Calling vigorously from marshes and drains in many localities in March and a sample collected (reg. no. 1967/4/2) from Memana. One was collected at "Dallen," Memana in September (reg. no. 1967/4/7).

REPTILIA

The reptiles of the Furneaux Islands are discussed by MacKay (1955) and Rawlinson (1967) both of whom collected specimens from the area. Comments on the species encountered during the visits of the present author, together with material from the area held in the Queen Victoria Museum are as follows:

Rock Lizard *Egernia whitii*. Mrs. D. M. Rhodes sent me a single specimen (reg. no. 1964/3/1) collected on 13 January 1964. M.T.L.E. Vogelpoel collected a short series (reg. no. 1967/3/17) at Trousers Point on 17 April 1965.

Southern Blue-tongue Lizard *Tiliqua nigrolutea*. Several were found dead on the road at various times. One was caught in a snap trap baited with raw meat and set for rats at Lackrana in September.

Tussock Skink *Leiolopisma entrecasteauxi*. This species is recorded by MacKay (1955) and Rawlinson (1967).

Three-lined Skink *L. trilineatum*. Four were collected at Memana in March 1966 (reg. no. 1967/3/12) and Mrs. D. M. Rhodes has forwarded to the Queen Victoria Museum a subadult (reg. no. 1967/3/1) collected on 6 January 1967. It was the most common lizard at Lackrana on my September visit and seven (reg. no. 1967/3/38) were collected.

Metallic Skink *L. metallicum*. Common in many localities and five (reg. no. 1967/3/11) were collected. Vogelpoel collected three (reg. no. 1967/3/13) on Mt. Chappell Island in November 1966. It was plentiful at Lackrana in September and three (reg. no. 1967/3/27) were collected.

Small-scaled Skink *L. pretiosom*. This species is included by Rawlinson (1967) in his Flinders Island reptile list on the basis of a single specimen (no. D911) held in the National Museum, Melbourne. Stephen Rhodes collected a female (reg. no. 1967/3/25) at Locotta on 3 September 1967 and another (reg. no. 1967/3/33) at Lackrana on 25 November 1967.

Spotted Skink *L. ocellatum*. Vogelpoel collected one (reg. no. 1967/3/14) on Mt. Chappell Island in November 1966. Stephen Rhodes collected a subadult (reg. no. 1968/3/5) at Locotta on 14 January 1968.

Bougainville's Skink *Rhodona bougainvillii*. MacKay (1955) collected a single specimen on Babel Island on 14 March 1955. A single specimen (reg. no. 1968/3/10) collected at Bull Point, Babel Island in the last week in April 1968 was sent to the Queen Victoria Museum by John Whinray. It was said to have been taken on the surface of the ground in a rookery (muttonbird) area. A number were collected on Waterhouse Island off north-east Tasmania by the author on 17 August 1962 (Green 1965) and subsequently a single subadult came to hand from Cape Portland on the mainland of north-eastern Tasmania in June 1964 (reg. no. 1967/3/9).

Mountain Dragon *Amphibolurus diemensis*. One was collected by Mrs. D. M. Rhodes in January 1964 (reg. no. 1964/3/2). Two were collected at

"Dallen," Memana in November 1966 (reg. no. 1967/3/18) and one was collected at Killiecrankie in September 1967 (reg. no. 1967/3/29).

Copperhead Snake *Denisonia superba*. One was collected at "Dallen," Memana in March and another at Lackrana in September. A small specimen of only 190 mm long and in a semi torpid state was collected from beneath dead grass at "Dallen," Memana on 20 September 1966. From the unpublished field diary of J. Kershaw, written on the occasion of a visit to an unnamed island near Mt. Chappell Island on 12 January 1909 he states "A Copperhead Snake was seen and an endeavour was made to secure it. It entered a Mutton Bird burrow and evidently bit the bird wh. came out of the burrow immediately and at once dropped dead (about 60 seconds)."

White-lipped Whipsnake *D. coronoides*. Two (reg. no. 1967/3/10) were collected at "Dallen," Memana on 23 March 1966.

Tiger Snake *Notechis ater*. Worrell (1963*a*) separates the tiger snake of the Furneaux Islands from other *Notechis* species and he (Worrell) 1963*b*) describes it as a subspecies *N. a. serventyi*. Vogelpoel visited Mt. Chappell Island on three occasions from 1963 to 1966 and has kindly supplied me with the following information. The first visit was in March 1963 when, in the course of one hour, 11 snakes were collected, all being between four and five feet in length. The second visit was made in February 1964 when over the five day period 85 snakes were collected. Of these, the smaller ones were released and only the largest specimens retained. From details supplied by Vogelpoel the following table has been compiled.

Measurements of 17 tiger snakes from Mt. Chappell Island, February 1964.

	WEIGHT (ozs)	TOTAL LENGTH (mm)	NUMBER OF SCALES		
			mid body	ventral	subcaudal
Maximum	50	1362	17	178	54
Minimum	8	790	17	164	44
Mean	22.3	1096.7	17	166.7	48.3

Only two of this series were lodged in the collections of the Queen Victoria Museum (reg. nos. 1966/3/19 - 20). His field notes show all 17 snakes collected were females and none showed evidence of pregnancy. Stomach contents consisted of mutton bird (*P. tenuirostris*) chicks, except in two cases, one of which was empty and the other contained a mouse (*M. musculus*). Fat deposits were extremely heavy, ticks were invariably present in the region of the head and neck and endo-parasitic worms were plentiful in many instances. Vogelpoel's field notes state in part "we witnessed a snake swallowing a young mutton bird. In less than 10 minutes the two foot six inch snake had managed to dispose of the developed young mutton bird" and again later, "We were interested to see that the weather seemed to have no effect on the snakes. We saw several even under the worst conditions" (referring to heavy rain). The third visit was made from 4 - 8 November 1966 when 24 snakes were collected and only 12 additional sightings made. This collection was purchased by the Queen Victoria Museum and registered as a bulk sample (reg. no. 1967/3/16). The series includes both sexes and ranges in length from 915 to 1515 mm. Ovaries were well developed but showed no embryonic development. In one

specimen they measured to 46 x 13 mm. From these remarks it is obvious that there has been a decrease in the number and average size of Mt. Chappell Island snakes. Worrell (1963*a*) described them as "a giant race with an average maximum length of nearly six feet and a known maximum of eight feet." When naming the subspecies he (Worrell 1963*b*) states, in part, under "diagnosis" "A giant robust race abounding on Chappell Island and commonly exceeding six feet in length." The largest snake collected by Vogelpoel barely exceeded five feet (measured after preservation) and was taken on his third visit when the numbers present appeared to be greatly reduced.

PISCES

Frankenberg (1967) discusses the galaxiid fishes of Flinders Island. We collected a small sample of freshwater galaxiids (reg. no. 1967/5/5) from the stream running through Smith's Gully. These have been determined by Mr. E. O. G. Scott as *Galaxias truttaceus scopus* Scott 1936. In November 1967 a sample collected from Chew Tobacco Creek at Lackrana included *G. attenuatus* (reg. no. 1967/5/32) and *Taeniomembras microstoma* (reg. no. 1968/5/12).

On 14 February Stephen Rhodes collected a fresh-water flathead *Pseudaphritis bursinus* (reg. no. 1969/5/17) in Locotta Creek, about a mile up stream from the coast.

Eels occur commonly in the creeks and drains and one lamprey species has been caught (D.M.R.)

DISCUSSION

About 151 species of birds have been recorded from the Furneaux Group of islands. They include two introduced Australian and seven introduced non-Australian species. A number of these records are doubtful and others require confirmation.

The collections of the Queen Victoria Museum include representatives of 59 species (including one introduced Australian and three introduced non-Australian) all of which have been collected recently on Flinders Island. An additional 69 species (including one introduced Australian and four introduced non-Australian) can be regarded as occurring there either permanently or with a reasonable degree of regularity. In my opinion the remaining 23 species require confirmation. Additional birds, particularly among the waders and oceanic species, can be considered as "probables" and further collecting and field observations will no doubt expand the present list.

Eighty-eight birds have been found breeding on Flinders Island or on other islands in the Furneaux Group. Further investigation will probably prove additional species to be local breeders.

Of the 14 endemic Tasmanian species listed by Ridpath and Moreau (1966) nine occur on Flinders Island and all, with the possible exception of the swift parrot which requires confirmation, are known to breed locally.

The reef heron, though once regularly recorded from the islands in Tasmanian waters, is now rarely if ever encountered there and it has been excluded from the list of confirmed species.

Of the two *Strepera* species which occur in Tasmania only the black currawong *S. fuliginosa* was found by us, though White and Mellor (1913)

record *S. arguta*. In Tasmania *S. fuliginosa* normally favours the highlands and rain forests, its place being taken in the lowlands by *S. arguta* (Sharland 1958)

The endemic Tasmanian native hen *Tribonyx mortierii* does not occur on Flinders Island, apparently being confined to its present range by its flightlessness. However, its near relative, the dusky moorhen, which occurs occasionally on Flinders Island, has not been found in Tasmania. There are no positive records of the Australian coot breeding in Tasmania though it has been found breeding on Flinders Island on several occasions.

The nankeen kestrel, rarely seen and with only one "possible" breeding record in Tasmania (Sharland 1952), is not uncommon on Flinders Island and breeds there fairly regularly. Indications are that it has benefited from pastoral development which has provided it with an increase in invertebrate foods. It has been seen more regularly in recent years, particularly in the Memana district.

Perhaps even more noteworthy are those species which are absent though they occur commonly in Tasmania and on the Australian mainland. In addition to those doubtfully recorded in the bird species list I have been unable to find any record of crake species, masked owl *Tyto castanops*, white cockatoo *Kakatoe galerita*, eastern rosella *Platycercus eximius*, yellow-tailed thornbill *Acanthiza chrysorrhoa*, and noisy miner *Myzantha melanocephala*.

Following the visit of the Royal Australasian Ornithologists' Union to Flinders Island in 1912, when the camp out was held near Lady Barron from 20 - 27 November, White and Mellor (1913) listed 65 bird species as seen in the area. With few exceptions, and apart from habitat alteration, their remarks indicate that the numerical status of most species has not declined to any extent since that time. The black-faced cormorant appears greatly reduced, probably due to the destruction of birds on the breeding rookeries by fishermen.

Some species show a marked numerical increase. The only reference made by White and Mellor (1913) to Cape Barren geese is of a single bird flushed from a small island in Franklin Sound and they fail to mention sighting such species as eastern swamphen and spur-winged plover. These birds would have been conspicuous if they were then anywhere near their present numerical status.

The absence of the dusky woodswallow from their list, together with the rarity of sightings except for migrating birds, adds support to the impression that few if any remain on Flinders Island to breed.

Land clearing and pastoral development has reduced the populations of some species simply by the alteration of habitat but this, in turn, has favoured species of the open grasslands. Perhaps the most spectacular population increase has occurred in the spur-winged plover which, over the last half century, has increased from what must have been a rare bird to one of the most common species. A similar increase has also occurred in Tasmania. The banded plover appears to be likewise favoured by pastoral development.

All the introduced species apparently are continuing their numerical increase, the most spectacular being the sky lark. This bird is now a striking feature wherever pastoral development has taken place, undoubtedly assisted by habitat alteration.

Some local naturalists assure me that some small passerine species such as robins and chats have increased in recent years and my own

observations support this impression. However, in the long term, many must decline in numbers as their preferred habitat continues to decrease with the land clearing and pastoral development.

It is inevitable that much more of the Flinders Island landscape will soon be changed to open pasture land and as development extends, acquisition of areas for natural reserves becomes more difficult and costly. There is an excellent area reserved in the Strzelecki Ranges and Logan Lagoon, with an area of adjoining land, recently has been proclaimed as a sanctuary but there are additional lowland areas on the east coast where such conservation measures could well be extended. The present demand for preservation of wetlands emphasises the need to save more of the eastern swamps and lagoons together with areas of the surrounding habitat which support numbers of local waterfowl and possibly forms an important link for migrating species moving between south-east Australia and Tasmania. Similarly, the preservation of a sample of the original environment in the Memana district should not be overlooked while a little still remains.

ACKNOWLEDGEMENTS

I wish to express my thanks to the people mentioned in the text who have given freely from their knowledge of the island's fauna which, in some instances, spans almost a lifetime. Especially I wish to thank Mr. Alex Dalgleish, Mr. David Rhodes and Mr. Eric Warren who kindly provided transport and accomodation during my visits and generally assisted in so many ways. Thanks are also due to Ansett-ANA for the transport of personnel and equipment to and from the island, to Mr. & Mrs. Jack Williams for hospitality and assistance, to Mr. Tom Burns for determining the botanical samples and Mr. W. J. M. Vestjens for some gut analysis.

The manuscript has been read by Dr. D. L. Serventy, Mr. J. H. Calaby and Mr. M. G. Ridpath, all of whom offered useful criticism for which I am most grateful.

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ALLANASPIDES HELONOMUS GEN. ET SP. NOV.

(Crustacea: Syncarida) from Tasmania

by

R. Swain, I. S. Wilson, J. L. Hickman and J. E. Ong

Records of the
Queen Victoria Museum
No. 35

Edited by
W. F. Ellis
Director of the Museum

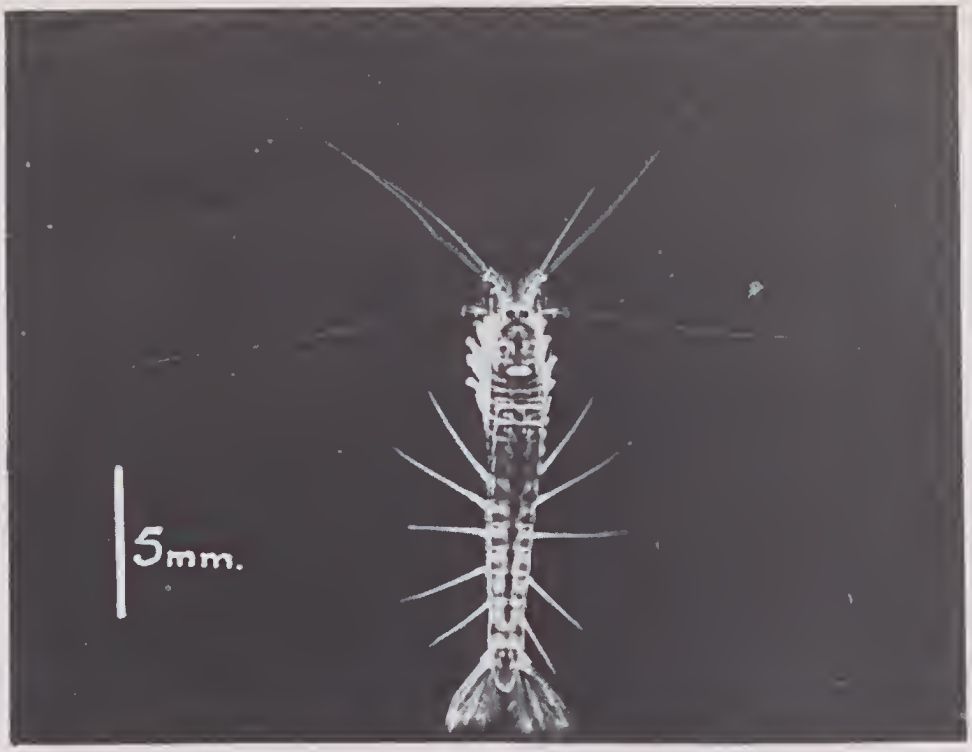

Plate 1. Dorsal view of adult male.

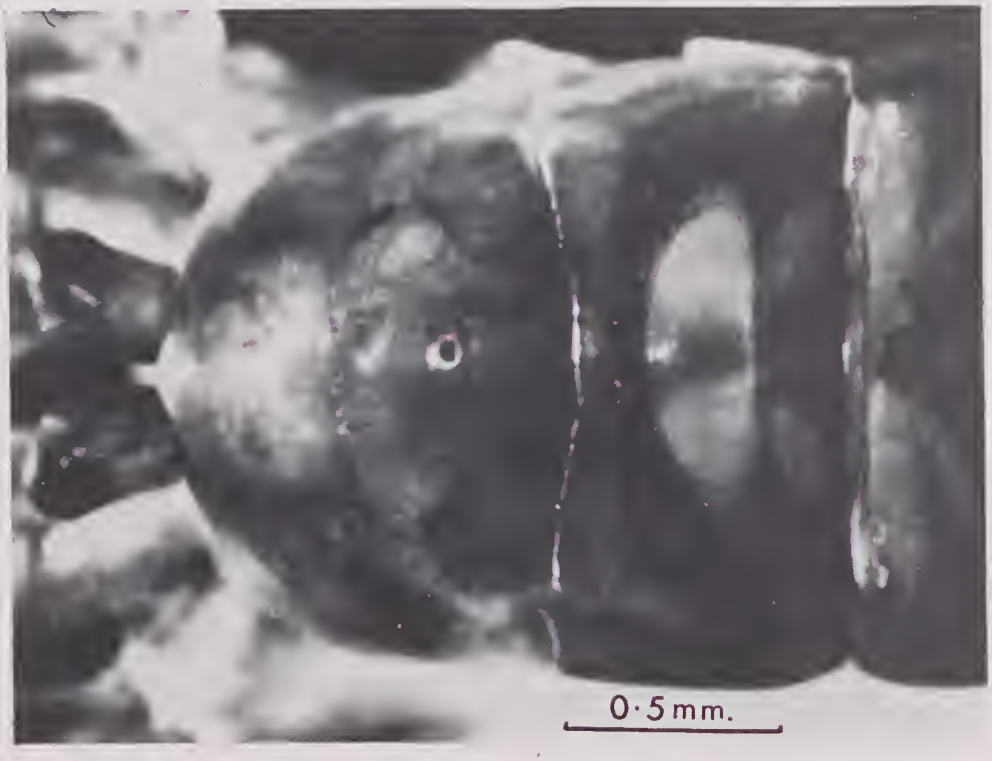

Plate 2. Dorsal view of anterior region of adult male.

ALLANASPIDES HELONOMUS GEN. ET SP. NOV. (CRUSTACEA: SYNCARIDA) FROM TASMANIA

by

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Manuscript received 6/1/70. *Published 18/2/70.*

ABSTRACT

An account of *Allanaspides helonomus* gen. et sp. nov. obtained from the burrows of *Parastacoides tasmanicus* Erichson and from pools on the buttongrass plain near Lake Pedder in south-west Tasmania is given. External features are illustrated.

INTRODUCTION

The known genera of the extant Anaspididae, *Anaspides* Thomson and *Paranaspides* Smith have been found only in Tasmania. While collecting the burrowing crayfish, *Parastacoides tasmanicus* Erichson, from the vicinity of Lake Pedder in south-west Tasmania in November 1969, two of the authors (R.S., I.S.W.) obtained specimens of an anaspid syncarid, which proved to be sufficiently different from the existing genera to require the erection of a new genus. A description of the species and the diagnosis of the genus are given below.

MATERIAL AND METHODS

Sixty-six specimens were obtained from the buttongrass plain about one hundred yards behind the Hydro-Electric Commission hut at Lake Pedder. Pits were dug to a depth of about two feet to drain the water from the burrows of *Parastacoides tasmanicus*. The water and debris from the pits were then carefully sieved, yielding 63 of the syncarids. The other three specimens were collected from the surface waters of flooded burrows without any preliminary digging. The animals were either immediately fixed in 5% formalin or brought back alive in water to the laboratory.

The animals were first studied whole. Structures requiring detailed investigation were dissected off and cleared in either lactophenol plus acetic acid or in clove oil. The orientation of structures was examined at this stage, prior to final mounting in polyvinyl alcohol or Canada balsam. Complete series of appendages and tergites of both sexes were prepared. Finally, in order to confirm details of segmentation, some appendages were boiled in 10% KOH and stained in acid fuchsin.

ALLANASPIDES HELONOMUS GEN. ET SP. NOV.

BODY FORM AND SEGMENTATION

Of the 66 animals obtained, one was a juvenile male, 26 were mature males and 39 were mature females. Size ranges (rostral tip to end of telson) are

shown below.

	Minimum length (mm.)	Maximum length (mm.)	Mean length ± S.D.
Juvenile ♂		4.4	
Mature ♂	7.0	13.6	9.91 ± 2.14
Mature ♀	5.7	13.3	8.65 ± 1.75

The general appearance of the animal, particularly the placement of the appendages, is shown in plate 1. In both living and fixed specimens there is a slight dorsal flexure of the body which involves all the thoracic and most of the abdominal segments. This flexure reaches its peak about the seventh thoracic segment in the male and the fifth thoracic segment in the female.

The body is divided into three tagmata: the cephalothorax (derived from the somites of the head and first thoracic segment), the remainder of the thorax, and the abdomen (plus telson).

The cephalothorax is divided dorsally and laterally by a clearly demarcated mandibular groove. The two regions so formed are unequal, the anterior being twice the length of the posterior. In the anterior region a very reduced rostrum is present which bears a few small setae on its lateral margins (fig. 1). The four-celled sense organ is very conspicuous and is visible medially in front of the mandibular furrow. The first region carries the following appendages: eyes, antennules, antennae, and mandibles. The second region bears the maxillules, the maxillae, and the first thoracic limbs. On each side of this region a poorly developed horizontal groove is present. Dorsally there is a large, clearly demarcated, transparent oval area which occupies about half of the dorsal surface (plate 2 and fig. 1). The term *fenestra dorsalis* is proposed for this area.

The seven segments which follow the cephalothorax are the free thoracic segments. Each bears a pair of limbs ventrally. The tergites lack lateral (pleural) lobes and increase in length anterio-posteriorly. The first three overlap considerably and consequently tend to accentuate the dorsal flexure of the body. The greatest width of the body is reached in the latter half of the thorax.

There are six segments to the abdomen. Each of the first five bears a pair of pleopods. The tergites of these segments are subequal in length, the first two being slightly longer than those following and equal to the last thoracic segment. Each tergite is extended laterally to form a pleural lobe on each side. The sixth abdominal segment is elongated, being nearly twice the length of the fifth. The setation of the third to sixth abdominal tergites is illustrated in fig. 21. The telson is elongated and pointed; it has between 60 and 70 stout, toothed setae on the posterior margin (fig. 22). The sixth abdominal tergite plus the telson are together longer than the three preceding segments.

THE APPENDAGES

Eyes:

The eyes are pedunculate with the eyestalks directed anteriorly, diverging at an angle of only 25 - 30°. The eyestalks project considerably beyond the rostrum (fig. 1). The eyes are situated medio-laterally. The inner margin of each eyestalk terminates distally in a small but conspicuous tubercle and carries a row of seven setae around the dorsal margin of the cornea.

Antennules:

The two rami of the antennules arise from a basal peduncle consisting of

three podomeres with a distinct flexure between the second and third (fig. 2). The distal podomere is somewhat elongated. An otocyst is clearly visible through the upper surface of the basal podomere. The inner flagellum is more than half the length of the outer flagellum and consists of between 50 and 60 segments. The outer flagellum is longer than the endopodite of the antenna.

Antennae:

The antennae (fig. 3) consist of a scale-like exopodite and a flagellate endopodite, borne on a two-segmented protopodite. The expodite is slightly longer than the first two segments of the endopodite combined.

Mandibles:

The mandibles are illustrated in fig. 4. The mandibular palp is three-segmented with the middle segment greatly elongated. The incisor process is well developed and carries five single teeth plus a large bifurcated apical tooth. An accessory incisor lobe bearing serrated setae is present between the incisor and molar processes.

Maxillules:

The maxillules consist of two rami borne on a basal podomere (fig. 5). The outer ramus possesses mainly serrated setae distally and a prominent conical palp on the epiaxial margin. The palp fits behind the body of the mandible. There are no setae on the epiaxial margin. The inner ramus extends slightly behind the outer ramus and carries brush setae, some of which terminate in combs; its epiaxial margin is fringed with clusters of simple setae.

Maxillae:

The two rami of the maxillae are bilobed and borne on a basal podomere (figs. 6 and 7). The innermost lobe is enlarged and extends in front of the next two lobes. The four lobes bear many long comb and brush setae. There are no setae on the outer margin of the maxilla.

Thoracic limbs - male:

There are no epipodites on the first thoracic appendages (fig. 8). Each limb consists of a two-segmented protopodite, the basipodite of which is not quite complete ventrally and bears a reduced simple exopodite dorsally and an endopodite ventrally. There are two gnathobasic lobes on the coxopodite, each consisting of a large setose preaxial lobe and a reduced post-axial lobe with few setae. Several types of setae are found on the lobes. The preischial segment of the endopodite forms an expanded setose lobe on the ventral surface. The dactylopodite of the first and all subsequent thoracic limbs bears a variable number of terminal claws (usually four or five).

The coxopodite of the second thoracic limb carries a pair of epipodites dorsally and a small coxal lobe ventrally (fig. 9). The basipodite is distinct from the preischium of the endopodite only on the preaxial and dorsal surface; it bears a well developed setose exopodite.

The limbs of the third to sixth thoracic segments are similar to those of the second except that the fusion of the preischium with the basipodite becomes progressively more complete (fig. 10).

The seventh thoracic limb is without an exopodite and the fusion between the basipodite and the preischium is complete (fig. 12). The coxopodite carries a setose coxal lobe distally and a non-setose papilla basally.

The eighth thoracic limb possesses neither an exopodite nor epipodites (fig. 14). The fusion between the basipodite and preischium is complete and no coxal lobes are present. The sternum is expanded ventrally and there is a single genital aperture in the midline, into which the vasa deferentia open.

Thoracic limbs - female:

The female thoracic limbs (figs. 11, 13 and 15) differ from those of the male in that:

a. the coxal lobes of the sixth and seventh appendages are well developed and prominent,

b. there is no coxal papilla on the seventh appendage,

c. the eighth limbs possess coxal lobes,

d. a large conical spermatheca is present between the eighth appendages,

e. the oviducts open on the inner postaxial margin of the coxopodites of the sixth thoracic limbs at the base of the coxal lobes.

Abdominal limbs:

Except for the first and second abdominal appendages in the male, the abdominal appendages of both sexes are uniramous; there are no endopodites (fig. 16). Each limb consists of a single-segmented protopodite and a long, segmented setose exopodite.

Endopodites are present on both the first and second abdominal appendages of the male, where they are modified to form complex copulatory styles. In the living animal they are directed anteriorly and are carried against the midventral surface of the animal between the last thoracic limbs.

The endopodites of the first abdominal segment are elongated and unsegmented (figs. 17 and 18). Basally each is grooved to provide a sleeve for the proximal segment of the corresponding endopodite of the second abdominal limb; terminally each provides an extensive covering for the distal segment of the succeeding endopodite. The margins of the endopodite are expanded distally into two flanges, one on the external margin (figs. 17, 18 - e.fl.), the other on the distal margin of the internal surface (figs. 17, 18 -i.fl.). That of the external margin is large and curved postaxially to enclose the bifurcated flange of the distal margin which itself curves inwards to form a terminal hood. The external flange also possesses a prominent proximally-directed flap postaxially (fig. 17 - f.), about halfway along the length of the endopodite, which meets the corresponding flap of the other first endopodite in the midline. Midway along the inner surface of the endopodite there is a raised plate possessing many small recurved hooks. These hooks interlock with those on the opposite limb and couple the two endopodites together. The postaxial surface of the inner margin bears a number of brush setae.

The endopodites of the second abdominal appendages consist of two segments, the proximal segment being about twice the length of the distal (figs. 19 and 20). On the postaxial surface of the proximal segment there is a prominent longitudinal ridge and a large basal projection. Basally, the inner margin bears a well developed flange; distally it possesses an extensive coupling plate, consisting of a raised pad of many small recurved hooks. Both the flange and the basal projection articulate with large sternal processes whilst the coupling plate locks firmly with the corresponding structure of the opposite limb. There is a large spur preaxially at the level of the coupling plate. A row of brush setae extends along the inner surface of the proximal segment, between the spur and the coupling plate. It extends throughout the terminal two-thirds of the segment. The distal segment is truncated; it possesses a shallow preaxial depression terminally, in which runs a longitudinal row of recurved hooks. Arising as a preaxial articulation with the proximal segment is a ridge which runs forwards and terminates in the depression.

Uropods:

The uropods are elongated with rather pointed tips. The arrangement of setae and spines is illustrated in fig. 23.

TYPE MATERIAL

Holotype: 1 adult ♂. Allotype: 1 adult ♀.

Collected from buttongrass plain near Lake Pedder in Tasmania (300 metres above sea level, approximately 146° 12' E and 42° 58' S) on 25th and 26th November 1969, by R. Swain and I. S. Wilson. Deposited in the Australian Museum, Sydney, Australia (reg. nos. P17619 and P17620).

Paratypes: 2 adult ♂♂ and 2 adult ♀♀ collected from type locality on 25th and 26th November 1969. Deposited in Queen Victoria Museum, Launceston, Tasmania (reg. nos. 1970.10.2 and 1970.10.3).

2 adult ♂♂ and 2 adult ♀♀ collected from type locality on 25th and 26th November 1969, deposited in Tasmanian Museum and Art Gallery, Hobart, Tasmania (reg. nos. G1299 and G1300).

ALLANASPIDES GEN. NOV.

Diagnosis:

Allanaspides gen. nov. may be differentiated from the other genera in the Anaspididae by the possession of the following characters:

1. the tergites of the thoracic segments increase in length from anterior to posterior,
2. the tergites of the first five abdominal segments are subequal in length and approximately equal to the posterior thoracic segments,
3. the sixth abdominal tergite plus telson are together longer than the preceding three segments,
4. there is a slight dorsal flexure to the body,
5. a large *fenestra dorsalis* is present in the cephalo-thoracic tergite,
6. the antennal exopodite is at least equal to the combined length of the first two segments of the endopodite,
7. the first thoracic appendages possess two gnathobasic lobes plus a setose expansion of the inner surface of the preischium of the endopodite,
8. the first thoracic appendages lack epipodites,
9. the seventh thoracic appendages lack exopodites,
10. abdominal endopodites are absent, except on the first and second abdominal appendages of the male.

Type species: *Allanaspides helonomus* sp. nov.

DISCUSSION

In the diagnosis of *Allanaspides* gen. nov. we have included those characters previously employed at the generic level in the Anaspididae (Smith 1909). Thus reference is made to the presence of a dorsal flexure, the lengths of the thoracic and abdominal tergites, the length of the antennal exopodite, the combined length of the sixth abdominal tergite and telson, and the presence of a preischial expansion on the first thoracic appendages. In all of these characters *Allanaspides* may be considered as occupying a position intermediate between *Anaspides* and *Paranaspides*. We have omitted reference to the mandibular palp, which, since the correction by Gordon (1961) to the description of *Paranaspides*, can no longer constitute a generic character. Smith (1909) also included the fact that the telson is shorter than the uropods, but since this is a feature shared by both existing genera and by *Allanaspides* gen. nov. it hardly seems a useful character at this level.

In addition to the existing criteria, four new characters are given generic status; namely, the absence of epipodites on the first thoracic appendages, the absence of an exopodite on the seventh thoracic appendages, the absence, except for the male copulatory styles, of endopodites on the abdominal limbs, and the presence of a *fenestra dorsalis*. This latter structure is of considerable interest since it immediately distinguishes *Allanaspides* gen. nov. from other genera and has no obvious counterpart in other crustacean groups. At this stage no suggestion as to its possible function(s) can be made, but anatomical investigations concerned with this point are in progress at both the light microscope and ultrastructural levels.

In the course of this study specimens of *Anaspides* and *Paranaspides* from their respective type localities were examined for comparative purposes. *Anaspides tasmaniae* was first reported by Thomson (1893) with a fuller description being provided a year later (Thomson 1894). Further information was added by Smith (1909) who also included a more detailed description of *Paranaspides lacustris* following his preliminary account (Smith 1908). These descriptions were found to be incomplete in certain respects, and it is apparent that detailed redescriptions are required. The Family Anaspididae was first diagnosed by Thomson (1893); this diagnosis was amended by Smith (1909). Siewing (1959) followed Thomson, but misquoted the date of his paper, giving it as 1886 which precedes the discovery of *Anaspides*. The discovery of the Genus *Allanaspides* necessitates a revision of the diagnosis of the Family, as provided by Smith (1909), since the presence of epipodites on the first thoracic appendages and of biramous abdominal appendages will no longer be valid at this level. The necessary revision and redescriptions are in progress.

Since the original discovery of *Allanaspides helonomus* was made in an area which is soon to be flooded for hydro-electric purposes, an extensive search is being conducted in order to ascertain the extent of the distribution of the animal. It is not yet known whether it is restricted to the burrows of *Parastacoides tasmanicus*, nor indeed whether it is confined to areas of buttongrass plain. Since preparing this account of *Allanaspides helonomus*, specimens have been obtained from one other locality (about ½ mile east of the McPartlan Pass; approximately 146° 12' S, 42° 52' E). This locality has also yielded 39 adult specimens of a second, sympatric, species of *Allanaspides*. A description of this second species is in preparation.

With the addition of *Allanaspides* gen. nov., the Family *Anaspididae* now comprises the following genera and species:

Genus *Anaspides* Thomson, 1894 (= *Anaspis* Thomson, 1893)
Anaspides tasmaniae Thomson, 1893
Anaspides spinulae Williams 1965

Genus *Paranaspides* Smith, 1908
Paranaspides lacustris Smith, 1908

Genus *Anaspidites* Brooks 1962 (extinct genus)
Anaspidites antiquus (Chilton 1929)

Genus *Allanaspides* gen. nov.
Allanaspides helonomus sp. nov.

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THOMSON, G. M. 1893. Notes on Tasmanian crustacea, with descriptions of new species. *Proc. Roy. Soc. Tasm.* 1892: 45-76.

_____ 1894. On a freshwater Schizopod from Tasmania. *Trans. Linn. Soc. Lond. (Zool.)* 6: 285-303.

Illustrations

All scales indicate 0.25 mm., except where otherwise indicated.

Figure 1. Anterior tergites and eyes of mature ♂. The tergites have been flattened to demonstrate the marginal setae.
fen. dors. = *fenestra dorsalis*.

Figure 2. Dorsal view of base of right antennule of mature ♂.

Figure 3. Dorsal view of base of left antenna of mature ♂.
end. = endopodite; ex. = exopodite.

Figure 4. Preaxial view of left mandible of mature ♂.
a.in. = accessory incisor process; in. = incisor process; mol. = molar process; plp. = palp.

Figure 5. Postaxial view of left maxillule of mature ♂.

Figure 6. Postaxial view of right maxilla of mature ♂.

Figure 7. Preaxial view of left maxilla of mature ♂.

Figure 8. Preaxial view of first thoracic appendage (right) of mature ♂. No attempt has been made to show the form of all the setae.
bas. = basipodite; g. = gnathobasic lobe; pre. = preischium.

Figure 9. Preaxial view of second thoracic limb (left) of mature ♂.
cox. l. = coxal lobe; ep. = epipodite.

Figure 10. Preaxial view of sixth thoracic limb (left) of mature ♂.

Figure 11. Postaxial view of base of sixth thoracic limb (right) of mature ♀.
gon. = gonopore.

Figure 12. Preaxial view of seventh thoracic limb (right) of mature ♂.
pap. = coxal papilla.

Figure 13. Preaxial view of base of seventh thoracic limb (right) of mature ♀.

Figure 14. Postaxial view of eighth thoracic limb (left) and sternum of mature ♂.
cox. = coxopodite; st. = sternum.

Figure 15. Preaxial view of base of eighth thoracic limb (left) and sternum of mature ♀.

Figure 16. Postaxial view of third abdominal pleopod (left) of mature ♂.
pro. = protopodite.

Figure 17a. Postaxial view of endopodites of first abdominal limbs of mature ♂.
e.fl. = external flange; f. = flap.

b. Diagrammatic representation of distal end of left first endopodite of fig. 17a with lobes unfolded.
i.fl. = internal flange.

Figure 18. Preaxial view of endopodites of first abdominal limbs of mature ♂.
c.pl. = coupling plate.

Figure 19. Postaxial view of endopodites of second abdominal limbs of mature ♂.
fl. = flange; b.p. = basal projection; l.r. = longitudinal ridge; st.p. = sternal processes.

Figure 20. Preaxial view of endopodites of second abdominal limbs of mature ♂.
r. = ridge; s. = spur.

Figure 21. Posterior abdominal tergites of mature ♂, flattened to include setation of pleural lobes.
III, IV, V, VI = segment numbers.

Figure 22. Dorsal view of telson of mature ♂.

Figure 23a. Dorsal view of left exopodite of the uropod of mature ♂.

b. Dorsal view of left endopodite of the uropod of mature ♂.

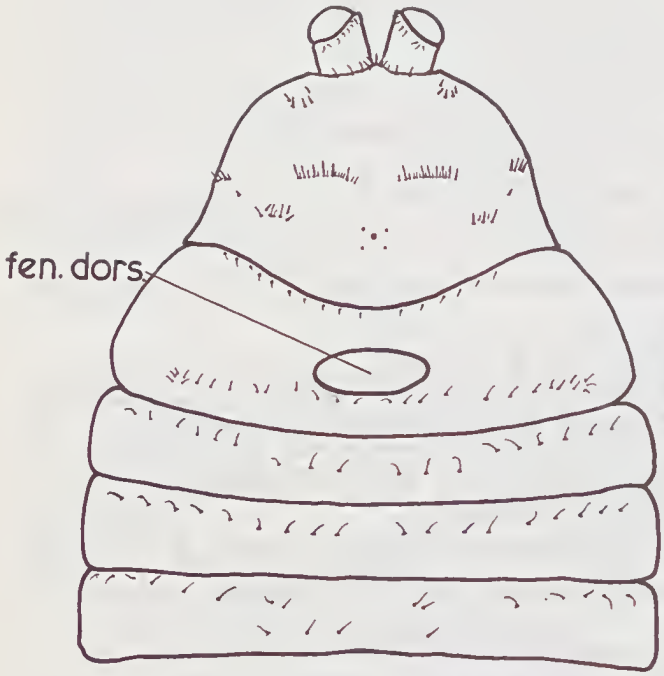
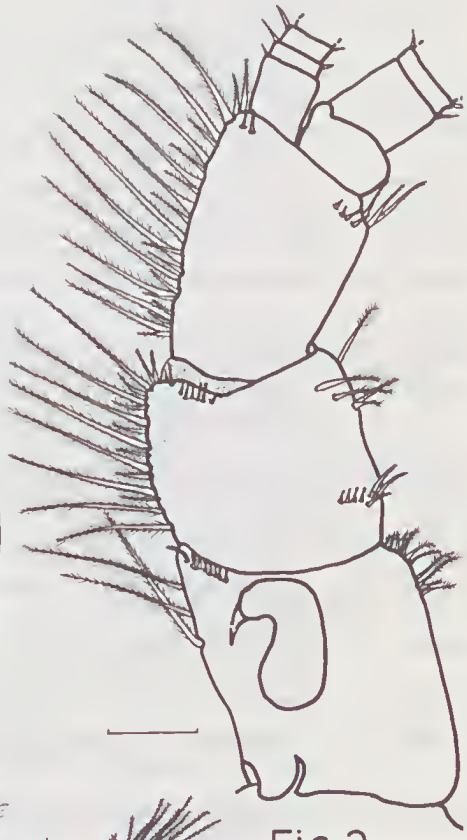


Fig. 1



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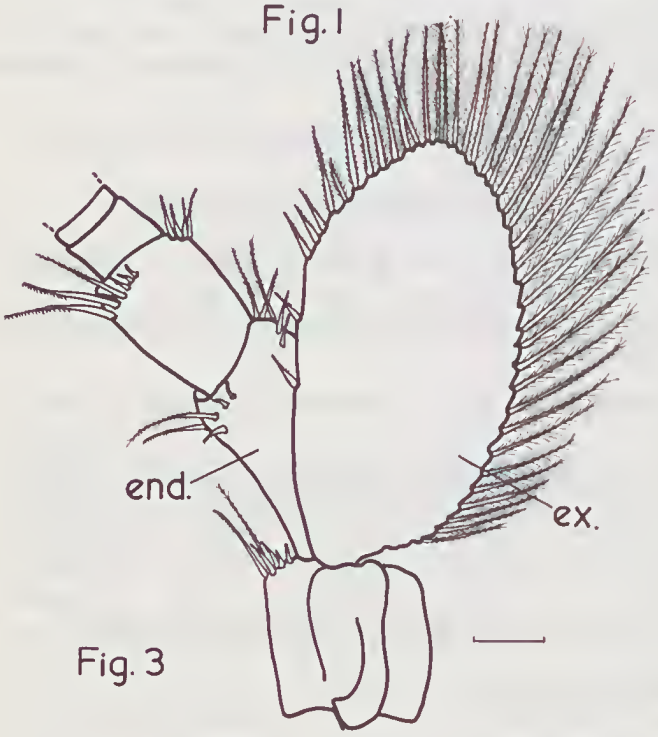

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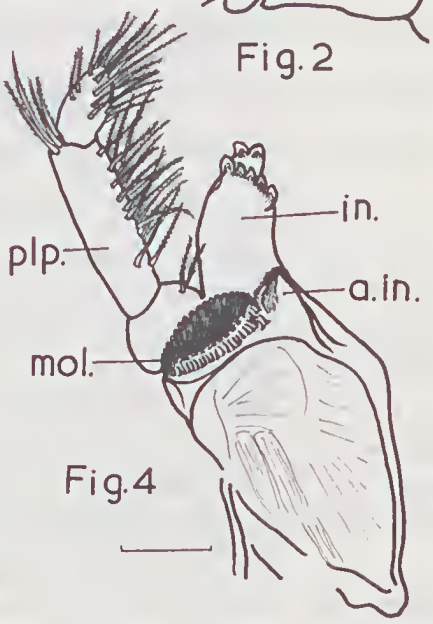
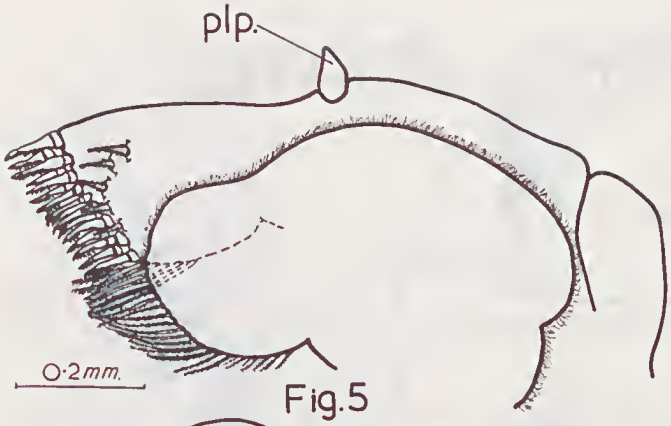


Fig. 4



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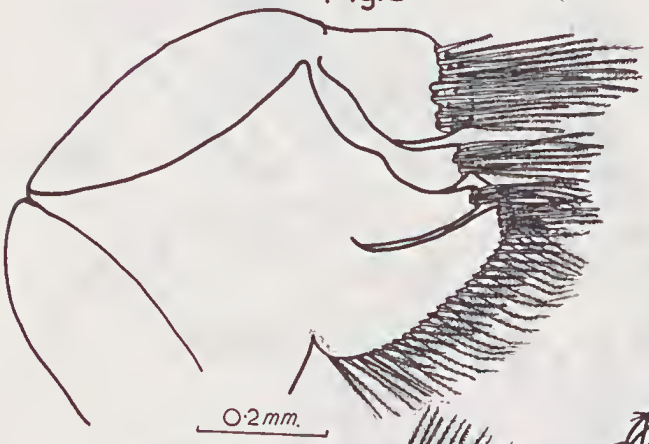

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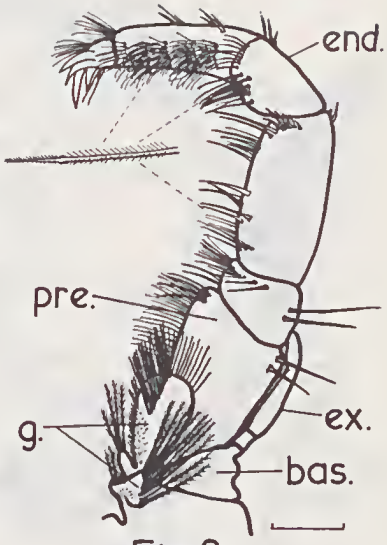


Fig.8

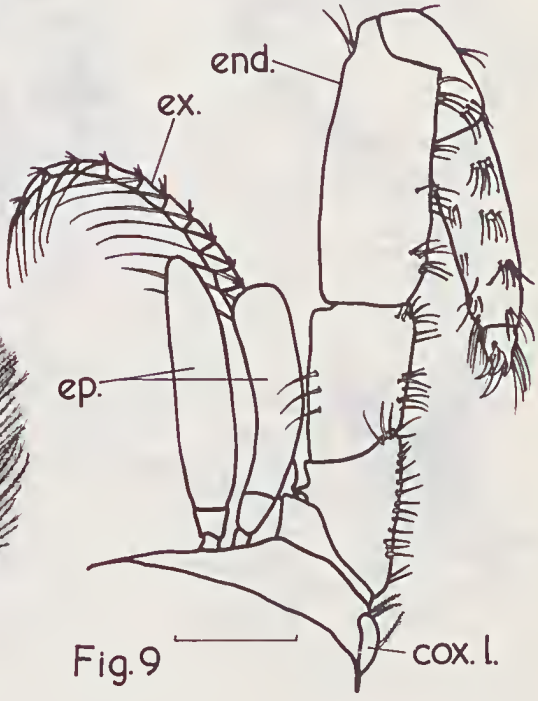


Fig.9

Fig. 11

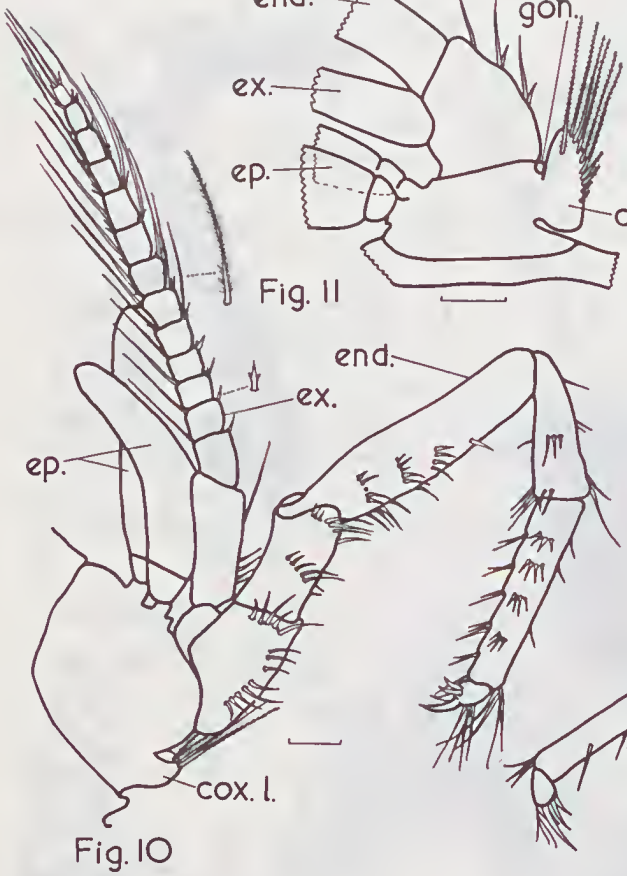


Fig. 10

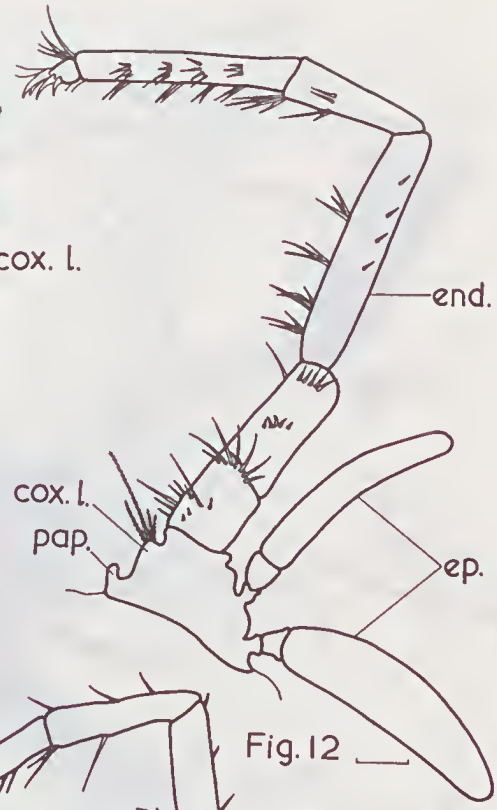
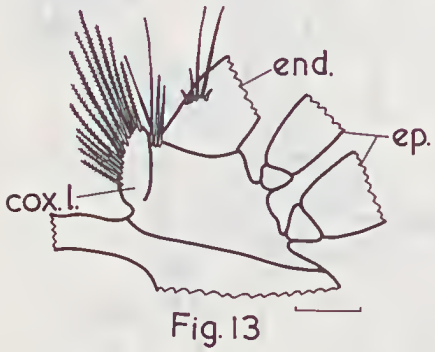


Fig. 12



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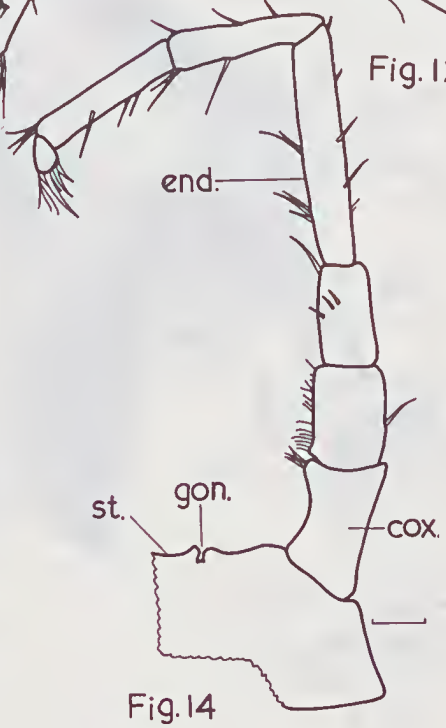

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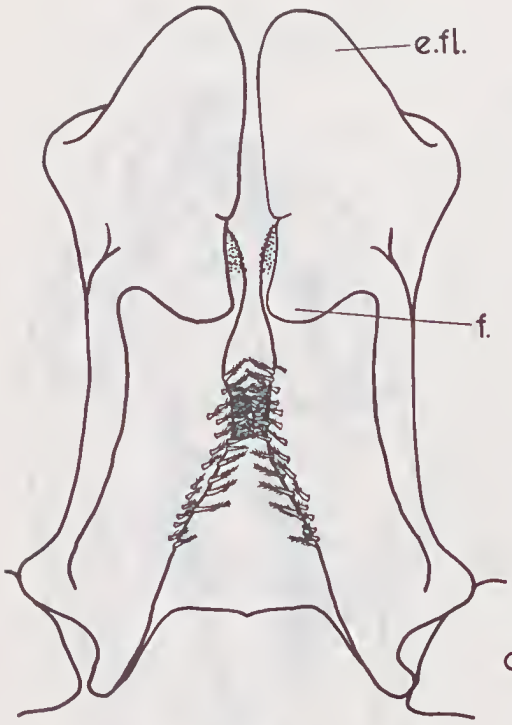

Fig. 17a

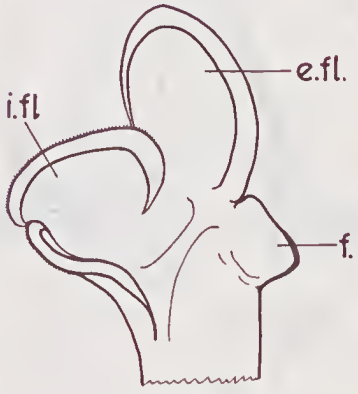

Fig. 17b

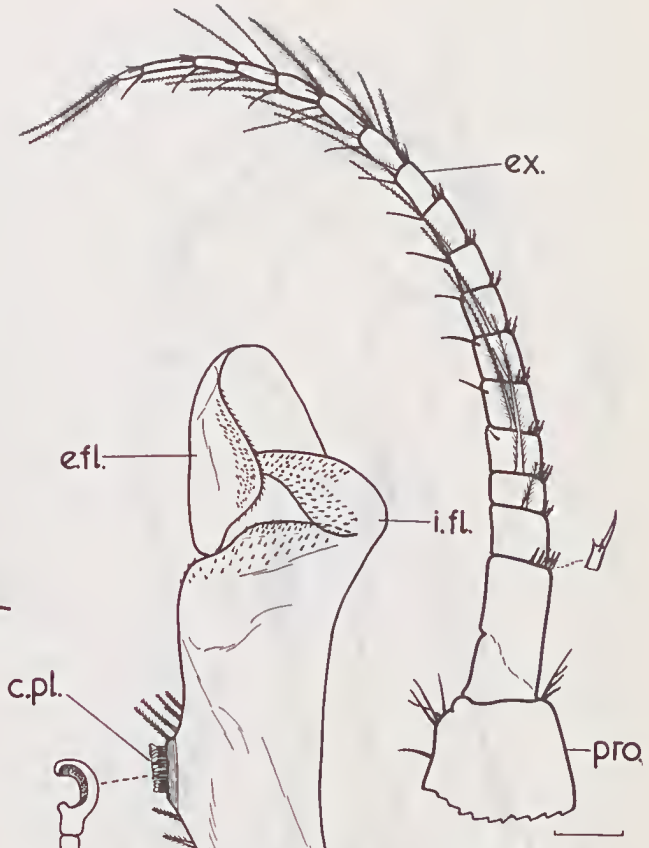

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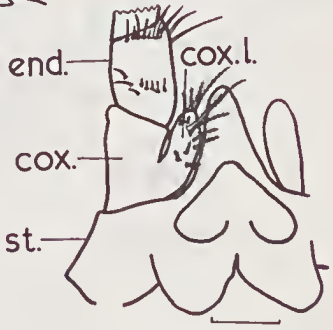
Fig. 18



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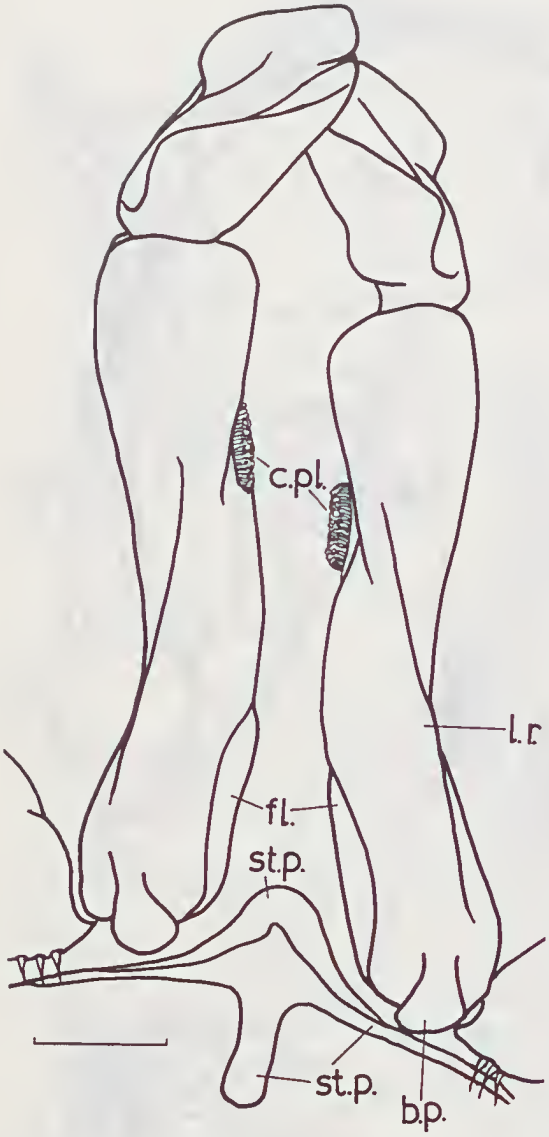

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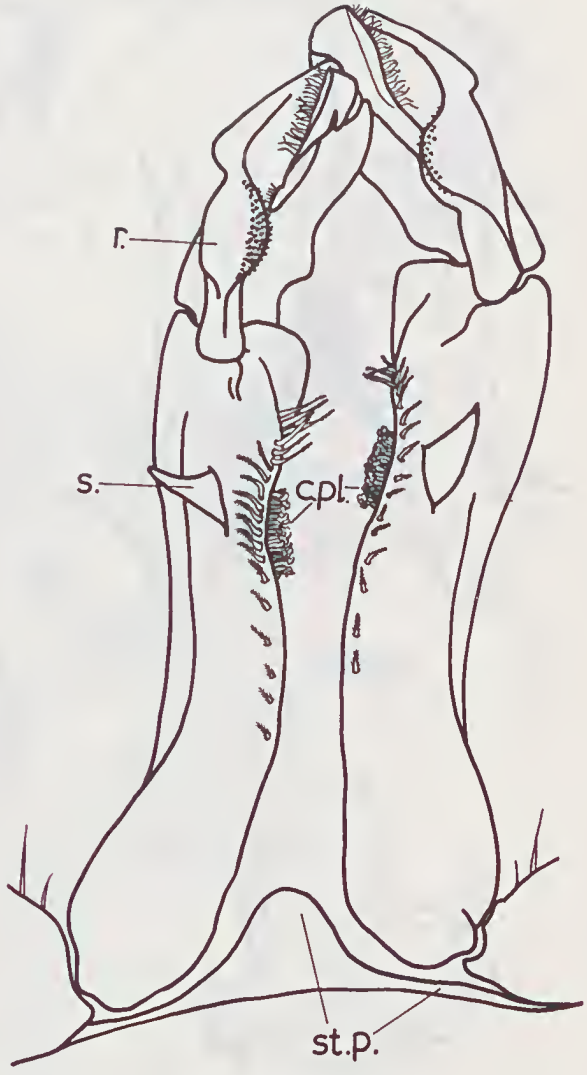

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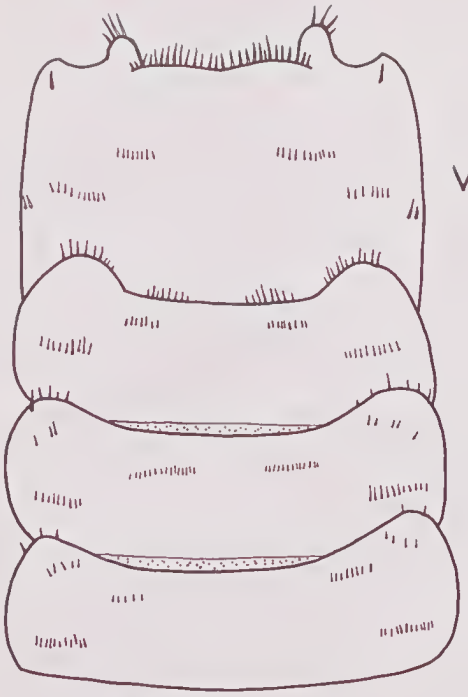
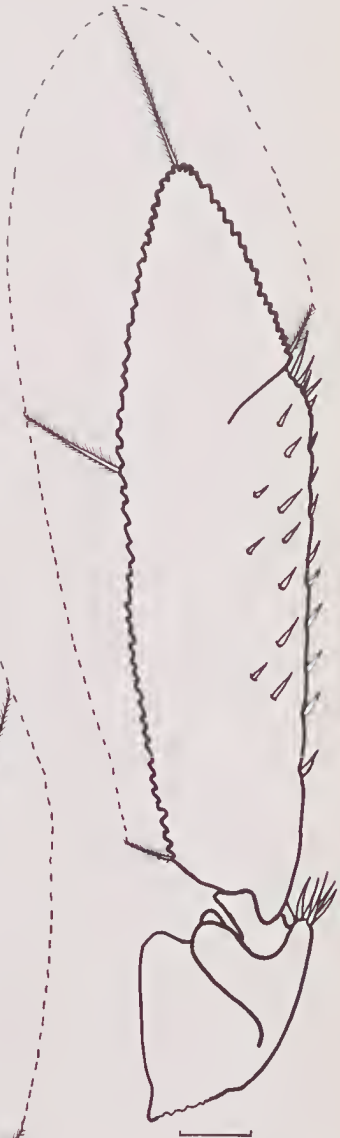


Fig. 21

Fig. 22

b.



a.

Fig. 23

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THE GEOLOGY AND PETROLOGY OF THE TERTIARY VOLCANIC ROCKS OF THE TAMAR TROUGH NORTHERN TASMANIA

by F. L. Sutherland

QUEEN VICTORIA MUSEUM — LAUNCESTON

36

THE GEOLOGY AND PETROLOGY OF THE TERTIARY VOLCANIC ROCKS OF THE TAMAR TROUGH NORTHERN TASMANIA

by F. L. Sutherland

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No. 36

THE GEOLOGY AND PETROLOGY OF THE TERTIARY VOLCANIC ROCKS OF THE TAMAR TROUGH, NORTHERN TASMANIA

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Manuscript received 28/11/69. *Published 12/2/71.*

ABSTRACT

Tertiary volcanic rocks outcrop extensively in the Tamar Trough in four main areas, in which their geological relationships and petrology are mapped and described in detail. They are mainly confined lavas, overlying Palaeocene-Eocene beds and later inter-volcanic sediments and lateritic profiles.

Volcanism commenced in post-Upper Eocene time and continued into at least mid-Tertiary time. Eruptions were spread over about a dozen centres, mostly located on fault lines, and gave volcanic successions up to 500-600 feet thick. Individual flows range from about 30 feet in thickness to coarse lavas several hundred feet thick, containing pegmatitic and differentiated phases and showing some intricate and partly intrusive contacts. The lavas caused drainage diversions and adjustments and yield information on old courses of the Tamar River.

The rocks are mostly undersaturated to nearsaturated alkali olivine-basalts, with minor olivine-nephelinite, nepheline-basanite, limburgite and tholeiitic olivine-basalt. The Tamar suite is, in essence, a typical example of the alkaline volcanic associations of Tasmania.

INTRODUCTION

The volcanic rocks occur along the Tamar Trough, a fault structure formed prior to, or early in, the Tertiary (Longman *et. al.* 1966). This Trough is a locus of Cainozoic drainage and considerable non-marine sedimentation. The volcanic rocks are mainly confined lavas, some of which preserve the course of the ancestral Tamar River at the time of eruption.

Prior to this study, the prevalence of lavas in the Trough was not fully realised, due to localised previous mapping and confusion of coarse grained lavas with the Jurassic dolerite basement. The general distribution, nature and relationships of the lavas were outlined in a preliminary note (Sutherland 1966*a*), and their mineralogy, petrochemistry and magmatic history is discussed elsewhere (Sutherland 1969*b*). This paper deals with the detailed geology and petrography of the lavas, condensed from an M.Sc. thesis submitted to the University of Tasmania (Sutherland 1968).

Access to the area is easy, with both the east and west Tamar

served by highways with numerous side roads; much of the area is cultivated, with easy terrain. The author's field mapping commenced in 1963, with aerial photographs on a scale of approximately four inches to the mile. Detailed topographic Lands and Survey maps became available for the area more recently and the geological maps presented here incorporate some control from these.

The author was employed at the Queen Victoria Museum, Launceston, during much of the study and collected specimens are held both there and in the Tasmanian Museum, Hobart. Thin section numbers refer to the Tasmanian Museum catalogued collection. Methods used in determining ranges of optical properties and compositions of minerals, quoted in the petrographic descriptions, are detailed in Sutherland (1969*b*). Mineral modes given were estimated using a microscopic grid and are approximate percentages.

PREVIOUS INVESTIGATIONS AND LITERATURE

Collections of local rocks were made by Lieut. Col. William Paterson with the establishment of European settlement at Port Dalrymple at the beginning of the nineteenth century. Some of this collection is held at the Queen Victoria Museum and is now only of historical importance.

Many of the early geological studies in the Tamar Valley were in the gold mining district of Beaconsfield and contributed little to the knowledge of the Cainozoic rocks, except the deep lead near Cabbage Tree Hill (Scott 1930). Most of these studies are reviewed amongst geological observations on the Tamar Valley (Kershaw 1955, 1958), in the geological mapping of the Beaconsfield square (Green 1959), and in later Tasmanian Mines Department reports (Noldart 1964). Early contributions on the Cainozoic rocks include studies by Johnston (1874, 1875, 1880, 1888), Etheridge (1881), Montgomery (1892) and Twelvetrees (1904), and some give observations on the basalts at Breadalbane and Tamar Heads.

Regional mapping of the Launceston district (Carey 1946), outlined the main features of the Tamar Trough and its geological history. Accurate dating of some of the Tertiary sediments provided some limits for the ages of the Trough and the associated basalts (Gill and Banks 1956; Gill 1962). Several investigations have been made of the Cainozoic sediments at Launceston in regard to foundation conditions (Longman *et. al.* 1966). Further detailed studies on the Tertiary sediments (E. D. Gill pers. comm.) are being prepared for publication by G. D. Aitchison (Commonwealth Scientific and Industrial Research Organisation) and E. D. Gill (National Museum of Victoria). The first petrological studies of the basalts (Johnston 1888; Petterd 1902; Edwards 1950; Green 1959) were limited to scattered samples. In a geomorphological study of the Launceston Tertiary basin, Nicolls (1960) discussed the ages of the basalts in that area and the lateritic surfaces developed on them.

Detailed investigations in some basalt areas provided valuable data. Investigations at Bell Bay commenced with enquiries as to its suitability as a port (Skeets 1922; Launceston Marine Board bore logs). Further investigations for industrial foundation sites included soil tests, seismic profiles and drilling programmes (Polak 1961; McLaren and Taylor 1961; Matthews 1966; Comalco-Bell Bay file reports). Exploratory programmes for a trans-Tamar bridge site by the Tasmanian Mines and Public Works Departments provided geological and sub-surface information on the basalts at Whirlpool Reach (Hughes 1958, 1959; Tasmanian Department of Public Works 1957) and Long Reach (Blake 1960; Maunsell and Partners 1959-1962). The

Beauty Point-Kelso area received attention in connection with wharf and navigational extensions (Launceston Marine Board bore logs) and landslip problems (Blake 1961; Jennings 1964*a*, 1964*b*). Basalt bearing sediments of probably Tertiary age were revealed by Tasmanian Mines Department foundation borings near Perth (Jennings 1965).

Further investigations are being conducted at present by the Tasmanian Department of Mines Geological Survey, as part of the 1" to 1 mile state mapping programme. The Longford Sheet (Blake 1959) was available prior to the present study, with the Launceston Sheet and explanatory report (Longman *et. al.* 1964, 1966) appearing more recently. At the time of writing, mapping of the Beaconsfield and Frankford Sheets is proceeding and will complete the coverage of the Tamar Valley area.

PHYSIOGRAPHY

The Tamar Valley is a broad, drowned, estuarine tract over five miles wide, in which the Tamar River rises from the junction of its North and South Esk tributaries at Launceston and flows some 35 miles out to Bass Strait.

The basalt extrusions have had important physiographic influences. More resistant than the Tertiary sediments, they cap the higher areas. Dissected basalt plateaux reach elevations of 700 feet in the Rosevears area and 600 feet north-west of Hillwood. Lower basalt plateaux, such as in the Bell Bay-Georgetown area at about 100 feet elevation, tend to be buried under younger Cainozoic gravels and sands. In areas lacking basalt extrusions, as between Hillwood and Native Point and between Dilston and Launceston, the Tertiary sediments are eroded to spurs, mostly less than 200 feet in elevation. Above the Tamar's head of erosion at Launceston, the sediments are preserved at higher levels and in the St. Leonards-Breadalbane-White Hills area there are dissected basalt plateau cappings at elevations at about 750 feet, with one small occurrence at about 900 feet.

The extrusions have influenced the course of the Tamar. The river originally appears to have extended further south through Evandale, prior to diversion from the Tamar Trough by lava around Breadalbane, west through Hadspen as the South Esk. Potentially imminent capture of the South Esk by Rose Rivulet at Evandale, however, if made, will re-divert the South Esk back into the Tamar Trough (Carey 1946). There is possible similar past diversion by the basalt flows in the lower Tamar, west through Beaconsfield and out the valley between West and Badger Head. Later extrusion upstream, however, may have diverted the river back to its original course. In contrast, in the middle Tamar the river appears superimposed on the basalt filling its old channel, and these points are discussed later.

Landslips are common in the Tamar Valley and are an important factor in the interpretation of outcrop; heels of slides or inferred slides have been mapped in this investigation. There are active movements above the Tamar's head of erosion at South Launceston (Longman *et. al* 1966) and also at Beauty Point (Blake 1961; Jennings 1964*a*), while historic slides have been recorded near Rosevears (Friend 1849). Erosive action of the Tamar drainage on the unconsolidated Cainozoic beds, with alternations of more permeable gravelly and sandy horizons and less permeable clay horizons, make valley slopes highly unstable; slumping soon becomes evident in new cuttings.

Resistant basalt cappings are wasted by undermining, a process

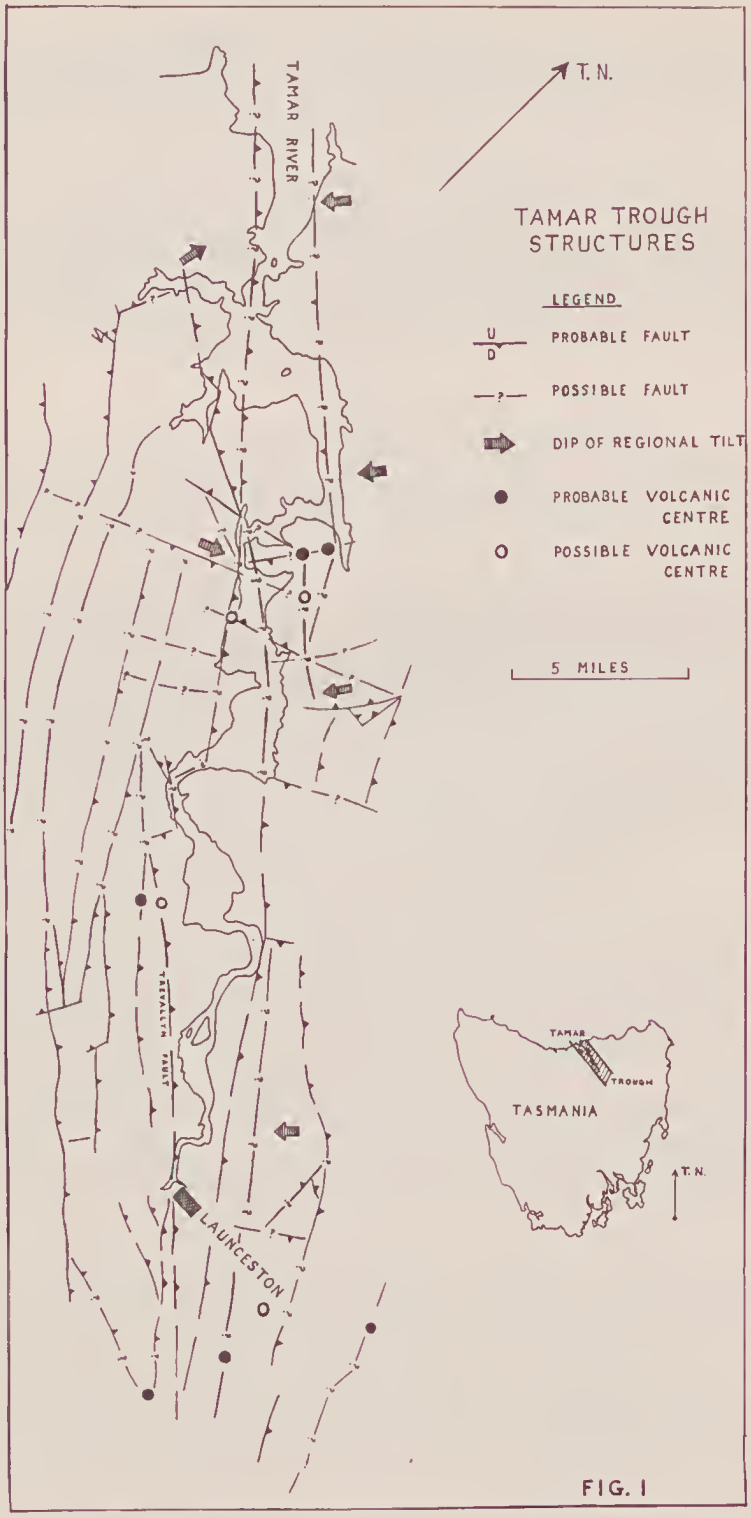

Fig. 1. Structures of the Tamar Trough.

enhanced where the course of the Tamar is superimposed over the old buried channels, so that the basalt base slopes down towards the river on both sides. This, combined with resultant overhanging of columnar and block jointing in the basalt normal to the base and downward slope of sheet jointing parallel to the base, provides extremely favourable conditions for movements. Failure takes place both by backward rotational sliding and by forward toppling, and valley sides in these areas have widespread mantles of basalt float. Large and extensive slides show toes with rocks rotated to near vertical positions. Very large blocks occur amongst the talus debris around Rosevears and Craigburn, and gaps amongst these form ravines and cavern systems, extending to depths of over 50 feet. The bushranger Brady is reputed to have exploited these features, keeping a watch for troopers from the basalt tor that bears his name and then eluding them by hiding in the caverns.

The future development of the Tamar Valley will require an increasing awareness of the widespread instability of much of the valley sides. Here may be mentioned the recommendations of restricted building zones at Beauty Point (Jennings 1964*a*), road shorings along highways, as between Muddy Creek and Rosevears, and the unconventional design of the trans-Tamar Batman Bridge, allowing minimum loading on the potentially more unstable eastern shore.

THE STRUCTURAL AND STRATIGRAPHIC ENVIRONMENT

THE BASEMENT STRUCTURE

The basement rocks are Permo-Triassic strata intruded by sheets of Jurassic dolerite. The dominant structure is the Tamar Trough, a north-westerly trending fault trough associated with late Mesozoic or early Tertiary vertical faulting and tilting (fig. 1). Cross sections in the Launceston area (Longman *et. al.* 1966) show south-westerly down-tilting of the basement of 5-20°, with the Trevallyn Fault marking the axis of a fault wedge and up throwing the western side. The author's mapping to the north indicates that the structure continues beyond the Tamar mouth, but differs in that the western side is down-tilted to the north-east, in opposition to the south-west tilt of the eastern side, and may pass into a graben north of Hillwood.

North-easterly tilts in the basement are first encountered north of Rosevears. The structural change appears to be associated with side-stepping of the Trevallyn Fault and a change in the form of the dolerite sheet, which to the north forms a long narrow body extending to West Head. This body is transgressive down to the north-east in the Beaconsfield-West Arm area, and granophyric dolerite near Deviot suggests differentiation in a dyke-like body, as demonstrated elsewhere in Tasmania (McDougall, in Spry 1962). The Trough structures are probably controlled in part by the Jurassic structure (Sutherland 1966*b*) and by underlying Palaeozoic-Precambrian features.

Ferruginous bauxites are developed on the basement dolerite at Whirlpool Reach, Rosevears, and around Launceston and St. Leonards, underlying Tertiary beds. Carey (1946) regarded the bauxite as remnants of a surface pre-dating the Tamar Trough faulting, but Gill (1962) infers that some, at least, post-date the faulting.

The Tamar Trough has been partly buried by subsequent non-marine sedimentation, interrupted by periods of erosion and lava effusions, and the stratigraphy is summarized in table 1.

LIST OF PLATES

1. Large ferruginous concretions in Lower Tertiary beds, Ruffins Bay, West Tamar.

2. Dolerite boulder beds (inter-volcanic Mid-Tertiary age?). Road cut, south of East Tamar Highway-Batman Bridge Road Junction, looking east.

3. Small faults in Lower Tertiary(?) beds. One mile north of Breadalbane, Midlands Highway, looking east, now covered.

4. Late-stage pegmatitic veins in coarse olivine-basalt. Rowella foreshore, West Tamar.

5. Tilted block of coarse olivine-basalt. North of Craigburn, East Tamar, looking south.

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6. Pillow-like lobe of coarse olivine-basalt, overlying and intruding near-vertical Lower Tertiary beds. Foreshore south of Batman Bridge, Whirlpool Reach, East Tamar, looking south.

7. Small fault displacing contact of coarse olivine-basalt overlying Lower Tertiary beds. Foreshore south of Batman Bridge, Whirlpool Reach, East Tamar, looking east.

8. Contorted Lower Tertiary beds below pillowy contact of coarse olivine-basalt. Locality as above.

9. Clastic dyke in coarse olivine-basalt overlying Lower Tertiary beds. Locality as above.

10. Pillowy lobe of coarse olivine-basalt, showing "necking" and a central cavity filled with sediment. Locality as above.

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PRE-VOLCANIC SEDIMENTS

Clays, sands, gravels and boulder beds, with lignitic and lateritic horizons, occupy the length of the Tamar Trough, underlying flows and lacking basalt fragments. Detailed descriptions of these beds in the upper Tamar-Launceston-Evandale areas are given by Johnston (1888) and Longman *et. al.* (1966).

In the lower and middle Tamar, the beds consist of light to dark brown, grey and yellow grits, sands, clayey sands, sandy clays, silty clays and clays, including dense carbonaceous clays and clay pellet horizons. Clays dominate, but some may represent altered feldspathic sandstones, with the original structure being destroyed on compression (Longman *et. al.* 1966, p. 20). These beds are commonly unconsolidated, and outcrops are poor, with exposures mainly restricted to the Tamar foreshores. Fossils include wood, leaf impressions, ramifying tube-like structures suggestive of worm burrows, and disorientated shells of the fresh water mussels *Prohyria johnstoni* and *Alathyria tamarensis* (McMichael 1957), particularly abundant around Spring Bay. Fossils often show ferruginous replacement, and ferruginous horizons with limonitic concretions are common; large entrail-like concretions, to over ten feet across, occur at Ruffins Bay (plate 1), Rocky Point and west Spring Bay.

Interbedded bands of "basalt," up to three feet thick, and down to depths of 250 feet below river level, are logged in some of the Long Reach bores (Maunsell and Partners 1959-1962) suggesting minor eruptions during sedimentation. However, in fact, these may represent passage of the drill through boulders or boulder beds, containing fine grained Jurassic dolerite, stripped off the roof of the intrusion; this was not resolved as the cores in question could not be located. Hughes (1959) records narrow beds of volcanic ash mixed with clays at Whirlpool Reach, but the present author was unable to verify these.

The sediments outcrop to elevations of 150 feet in the lower Tamar, to over 400 feet in the middle Tamar, 600 feet in the upper Tamar, and 800 feet south of Launceston. They are proved to depths below river level of at least 140 feet in the lower Tamar, 300 feet in the middle Tamar, and 270 feet around Launceston (Launceston Marine Board bores; Maunsell and Partners 1959-1962; Longman *et. al.* 1964). This gives a maximum thickness of at least 1,000 feet.

The beds are broadly horizontal, but show regional dips of up to about 10° in from the trough margins. Locally, as a result of later faulting, landslipping and lava flow, they show considerable variations in attitude, ranging from gentle warps forming small dome and basin structures to steep, near vertical drags. Steep, rectangular to rhombic blocky jointing is well developed at a number of places. Small faults cut the sediments at Whirlpool Reach (fig. 7), Deviot (8567E - 2063N), in the underpass above Strathlyn on the West Tamar Highway, and north of Breadalbane (0810E - 8780N; plate 3) where the dislocations reflect in miniature the south-westerly tilting and strike slip faulting of the trough structure of Longman *et. al.* (1964, 1966).

The sediments have been dated palynologically as Palaeocene at Muddy Creek, Palaeocene-Lower Eocene at Launceston and Rose Rivulet, post-Palaeocene/pre-Miocene at Evandale, Eocene at Bell Bay, and Middle Eocene at Spring Bay (Gill 1962; Harris 1968; E. D. Gill pers. comm.).

INTER-VOLCANIC SEDIMENTS

These include similar clays, sands and gravels to the Palaeocene-Eocene beds, but are interbedded with basalts or contain basalt fragments. Precise datings for these sediments are uncertain, but they probably range from post-Upper Eocene to mid-Tertiary ages.

Several bores through basalt at Bell Bay revealed intervening sediments (McLaren and Taylor 1961). This horizon overlies the lower basalt at 80 to 100 feet above river level and consists of sands, carrying basalt pebbles in places.

Dolerite conglomerates at least 50 feet thick, disconformably overlie Middle Eocene beds at elevations of 50 to 500 feet above river level between Hillwood and East Arm, but underlie the flow of coarse basalt. They consist mainly of rounded pebbles and boulders of Jurassic dolerite, to several feet across, in a silty to clayey matrix, and are well exposed in road cuts at the East Tamar Highway-Batman Bridge Road Junction (plate 2). One pebble collected from the conglomerate (8945E - 2312N) in thin section (189) proved to be olivine-basalt, petrologically identical to the lower basalt at Bell Bay. This gives the conglomerates an inter-basaltic age, and they are tentatively correlated with the sediments between the upper and lower flows in the lower Tamar.

Large boulders and blocks of Jurassic dolerite on the east bank of Whirlpool Reach at the Batman Bridge range to over twelve feet across and suggest outcrop. However, bores here passed through into underlying Lower Tertiary beds at depths between five to seventeen feet (Tasmanian Department Public Works 1957; Hughes 1959). Thus, some or all of the dolerite represents an old talus deposit, either mantling an underlying protruding dolerite ridge, or derived from the dolerite on the western bank of Whirlpool Reach. The deposit marks an apparent constriction in the pre-basalt channel of the Tamar through Whirlpool Reach (fig. 6) suggesting that it may pre-date the coarse basalt and be comparable in age with the dolerite conglomerates of the Hillwood-East Arm area.

Inter-volcanic dolerite conglomerates, associated with clays and sands, also underlie basalts in the south Tamar around Rose Rivulet. These beds extend from elevations of 300 to 750 feet, disconformably overlying Palaeocene-Eocene beds and containing rare fragments of weathered basalt. Blake (1959) mapped these as Pliocene boulder beds, but they are probably older, and are tentatively correlated with the dolerite conglomerates in the middle Tamar.

A further inter-volcanic conglomerate may be represented at the base of the coarse basalt in the railway cutting 1¾ miles north of Western Junction Station, but the contacts are not completely exposed. The deposit is at least six feet thick, shows some consolidation and imbrication, and includes worn fragments of basalt, Jurassic dolerite and quartzite, up to boulder size. The basalt fragments in thin sections (194, 576) are petrologically similar to the olivine-basalt east of Rose Rivulet. An underlying position for this conglomerate would indicate that it is younger than the other sub-basaltic conglomerates of the area and that the coarse basalt post-dates the basalt east of Rose Rivulet, with an intervening period of erosion.

Other inter-volcanic horizons may include lateritic horizons developed on olivine-nephelinite, north of Spring Bay in the middle Tamar, and on lower olivine-basalt, above Strathlyn in the upper Tamar, both of which appear to underlie later basalts. Inter-volcanic sediments deposited upstream from earlier basalt flows, or at times of minimum erosion, would

lack transported basalt fragments and be difficult to distinguish from the pre-volcanic beds.

POST-VOLCANIC SEDIMENTS

These include siliceous, doleritic and/or basaltic gravels, sands and clays (in some cases not easily distinguished from pre and inter-volcanic deposits), as well as laterites, talus and landslip debris, soils, aeolian sands and alluvium.

Clays and gravels, probably of Upper Tertiary age, were drilled near Perth Railway Station to depths of 50 feet (Jennings 1965). The gravels contain numerous basalt pebbles in many of the horizons and their proximity to the coarse basalt near Perth suggests that the beds post-date the flow and are probably fluviatile deposits of the South Esk. Beds of similar age are exposed in new road cuttings south-east of Perth Bridge, where they disconformably overlie decomposed coarse basalt, with a basal horizon rich in ironstone gravel followed by seven feet of consolidated, friable sands and sandy clays. The beds are gently warped and broken by small north-westerly faults with throws of a few feet.

Widespread deposits of siliceous gravels, sands and clays disconformably overlie basalts in the Tamar Trough (Johnston 1888; Carey 1946; Kershaw 1955, 1958; Green 1959; Blake 1959; Nicolls 1960; McLaren and Taylor 1961; Matthews 1966). These beds are generally unconsolidated, but in Kelso Bay (7350E - 3600N) strongly silicified quartz conglomerate outcrops at river level. Their precise ages are uncertain, but, in the south Tamar (Brickendon Gravels; Nicolls 1960), they are younger than the post-basaltic beds at Perth and are probably late Tertiary or Pleistocene.

Well developed benches are associated with these beds and may relate to old marine stands, with or without tectonic involvement. In the lower Tamar, benches are found at about the 250 feet and 200 feet levels east of Beauty Point, and a prominent and widespread terrace stands between 100 to 150 feet in elevation around Bell Bay, George Town, Lyetta and the south end of West Arm. A possible old shore-line or storm beach deposit at a comparable elevation occurs just north of Beaconsfield (Green 1959) and there is evidence of a former shore-line cut at about 110 feet above M L W S south of Greens Beach (Kershaw 1958). Other benches attributed to marine levels have been recorded at 70-80, 40-50, 25-30, and ten to fifteen feet above sea-level (Green 1959; G. M. Dimmock, K. D. Nicolls, R. C. Kershaw, pers. comm.). Similar levels to these latter ones, on King and Flinders Islands, are probably related to marine levels in the last Interglacial and Post-Glacial periods, while higher levels are probably older than the last Interglacial (Jennings 1959; Kershaw and Sutherland unpubl. ms.) Gravels and clays, up to 75 feet thick, overlie coarse basalt and Tertiary sediments in the Tamar channel at Long Reach to depths of over 140 feet below river level (Maunsell and Partners 1959-1962); these may represent deposits related to lower sea-levels following the last Glacial.

Remnants of lateritic profiles are developed across the basalts, Tertiary sediments, and dolerite of the Tamar Trough; in the south Tamar these represent the Woodstock Surface of Nicolls (1960), regarded as probably Pliocene in age. The profiles form undulating surfaces, reflecting old profiles of the Tamar Valley and sloping from elevations of 990 feet down to 550 feet in the south Tamar and from 450 feet down to 50 feet at the lower Tamar. They tend to be preserved in depressions or fringe slopes on the present land surface. They consist of reddish kraznosems or sandy soils associated with boulders of nodular, pisolitic ferricrete, which may contain fragments of underlying parent rock. Pallid,

weathered lower zones in these profiles are seen in basalts 3/4 mile north of Craigburn, about one mile east of Whirlpool Reach, on the plateau south of Atkinson's Creek, and south-east of White Hills. The age of the laterite horizons is uncertain, but where pallid lower zones are developed they resemble the Timboon Terrain in Victoria, dated as Lower Pliocene (Gill 1964). Where ferricretes are only weakly developed or not associated with any marked weathered profiles, as on the post-volcanic siliceous beds and on basalts in the lower Tamar, they may represent semi-lateritisation, such as developed under Pleistocene climatic conditions in Victoria (Gibbons and Gill 1964).

Talus and extensive landslip debris clothe many of the valley slopes in the area. These include pebbles shed from dolerite gravels, extensive float derived from basalt cappings, gravel and sand shed from post-basaltic siliceous deposits, ferricrete fragments and "buck shot" ironstone gravels derived from lateritic profiles, and deep soils developed on Lower Tertiary beds. Basaltic float is particularly extensive around Bell Bay, Beauty Point, north of Hillwood, Craigburn, Deviot, Spring Bay, Moriarty Reach, Long Reach, East Arm, Brady's Lookout, Gaunt's Hill, Atkinson's Creek, Muddy Creek, and Rose Rivulet, and was discussed under landslip features. Huge toppled blocks to over 50 feet high and hundreds of feet across (plate 5) are mapped as solid masses, north of Craigburn. Many of the slides, associated with talus, were presumably initiated by active channel cutting and erosion by the Tamar drainage following sea-level fall in the last Glacial period, and movements are still current. Ferruginous cementation of talus is seen in road cuts in the West Tamar Highway south of Atkinson's Creek (9165E - 0844N) and west of Brady's Lookout (9010E - 0971N); this suggests that these deposits are older than the typically uncemented talus and are probably pre-Holocene or even pre-Pleistocene.

Late Quaternary windblown siliceous sands are developed at the Tamar Heads, where littoral sands extend over older post-basaltic deposits as far south as Bell Bay, and also occur inland in the south Tamar (Nicolls 1960). Recent coastal calcareous sands form stabilised dunes and beach ridges around the Tamar mouth. The alluvium of the present Tamar drainage includes gravel and sand deposits, seen in the slip-off slope at Native Point, in the spit at Swan Point, and in pebbly and sandy beaches, and there are extensive tidal mud flats and flood plains. The terrace systems associated with the drainage in the south Tamar are discussed in detail by Nicolls (1960).

VOLCANIC ROCKS

These are dominantly basaltic and alkaline lavas, with rare pyroclastic deposits. Stratigraphical relationships indicate that the volcanism commenced in post-Eocene and continued into at least mid-Tertiary time. The eruptive vents are not obviously exposed, but a number can be recognised or inferred from field criteria such as listed by Burns (1964), from detailed petrology, or from gravity anomalies. The lavas erupted from about a dozen centres spread along the Trough, mainly on fault lines, and relationships of detected centres to the structures of the Tamar Trough are shown in fig. 1. A cluster of centres in the Deviot-East Arm area is associated with intersecting faults and an apparent change in structure from a fault wedge to a possible graben.

The lavas are mostly undersaturated to nearsaturated alkali olivine-basalts, with minor tholeiitic olivine-basalt, and alkaline rocks include nepheline-basanite, limburgite and olivine-nephelinite (Sutherland 1969*b*). They occur in four main areas (fig. 2, table 1), discussed in detail separately.

Fig. 2. Distribution of the Tertiary Volcanic rocks of the Tamar Trough.

FIG. 3 Beaconsfield

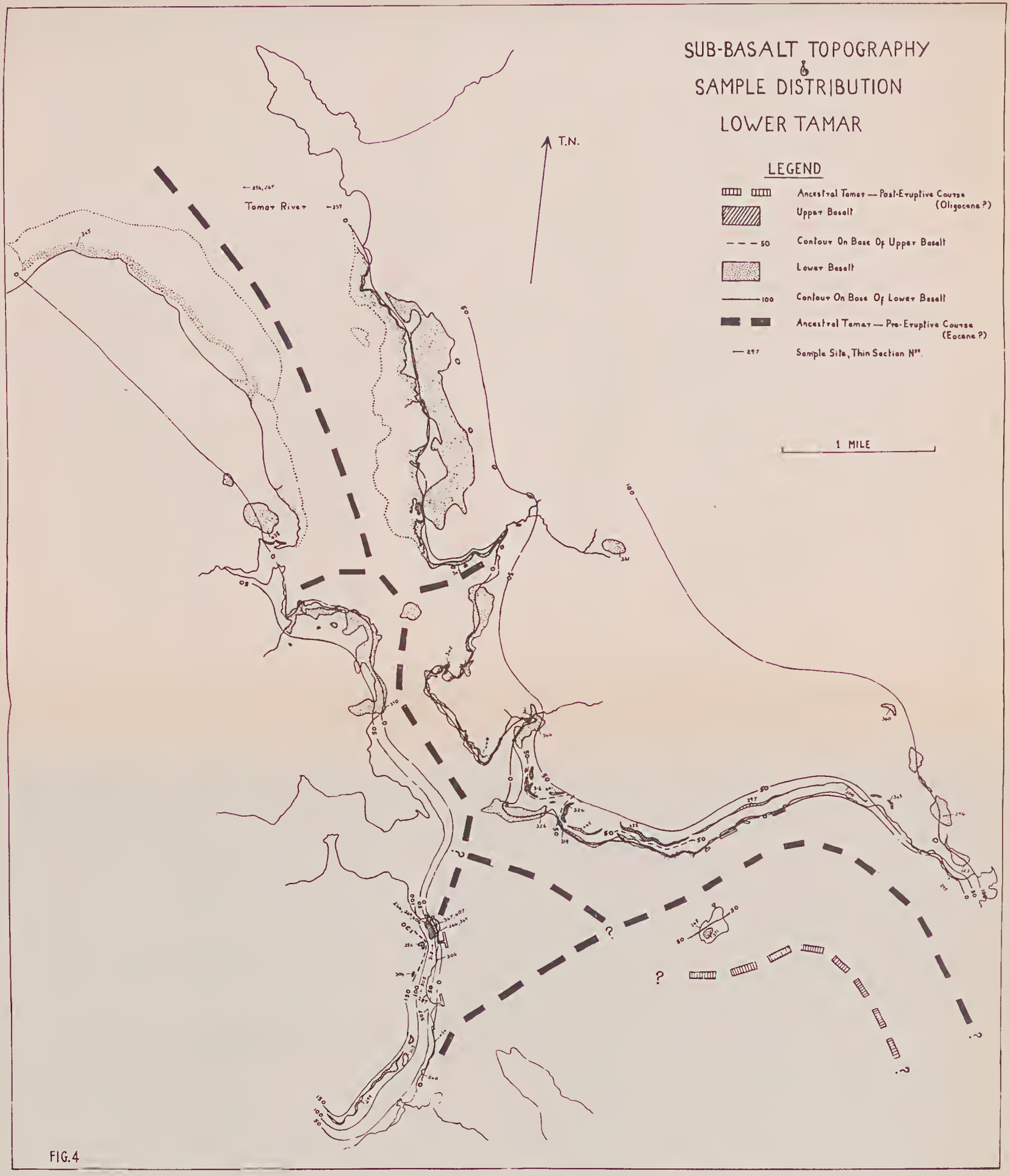

FIG.4

Fig. 4. Map of basal contours on basalt, Lower Tamar area.

LOWER TAMAR

Two basalt flows outcrop in the area (figs. 3 and 4), separated by an interval of erosion and sedimentation (McLaren and Taylor 1961).

LOWER OLIVINE-BASALT

This basalt fills a channel following a similar course to the present Tamar (fig. 4). A small steep tributary valley side at Inspection Head wharf was straddled by Launceston Marine Board bores; Bore 1 drilled underlying Tertiary sediments to 70 feet below Astronomical Low Tide, and Bore 2 drilled basalt to 59 feet below A.L.T., without passing through. Similarly, bores at Garden Island and Barrel Rock intersected basalt to 42+ feet below A.L.T., but basalt overlies sediments at many points along the Tamar shores. Inland, the base rises to elevations of 150 feet giving a maximum basalt thickness of 210+ feet and an average cross-sectional slope of one in thirteen for the pre-basalt Tamar valley, but steepening greatly along the main channel.

The basalt is massive, with strong, irregular and rectangular jointing and shows cooling columns around Point Effingham, Georgetown, Lyetta, Greens Beach and Low Head. Joint planes in bores at Bell Bay show polishing indicating slight movement and some contain pyrite (McLaren and Taylor 1961). When fresh, the basalt is dense, even grained and darkish blue-grey rock, with sporadic amygdales containing carbonates. It decomposes to soft blue or brown clay on the surface, with erratic weathering extending to varying depths. The base is slightly scoriaceous and weathered at contacts, and baking of underlying sediments generally extends for a few inches and rarely for two to three feet.

Petrology

Thin sections (30 slides, fig. 4) show corroded olivine phenocrysts in a groundmass of plagioclase, pyroxene, olivine and iron ore, with intersitial carbonate, chlorite, serpentine, zeolite, glass, opal and chalcedony (plate 1, Sutherland 1969*b*).

Olivine (12-17%; 2.5 mm. max. size; $2V_z$ 88-96° $\simeq Fo_{91-76}$) is partly altered to limonite, serpentine or carbonate. Plagioclase (38-49%) forms zoned labradorite laths ($\simeq Ab_{40-50}$; to 1 mm. long, sometimes flow aligned) passing into intersertal sodic plagioclase. Colourless augite (24-27%; $Z:c 44-46^{\circ}$) is interqranular, mostly less than 0.2 mm., but to 1.2 mm. across in rare pyroxene aqgregates (368). Iron ore (6-11%, to 0.5 mm.) occurs as elongate laths, irregular intersertal masses and squarish grains. Small apatite needles are common in the intersertal plagioclase and some colourless glass may be present (343, 365).

Late interstitial and amygdaloidal material (up to 20%) is predominantly carbonate (319, 341, 342, 345, 366, 370), or serpentinitic, nontronitic and chloritic clay (257, 294, 297, 299, 303, 340, 344, 369), or both (261, 326); rarely it is zeolite, with properties resembling chabazite (256, 267). Green opal is present in some sections, sometimes with greenish or blackish chalcedony (294, 295, 340, 345, 367, 368). Sporadic larger ovoid amygdales generally contain clay or carbonate. Rare small xenoliths (368) are composed of anhedral quartz and carbonate, bordered by a corona of colourless augite prisms to 0.7 mm. long.

The rock is a nearsaturated alkali olivine-basalt, (Analysis 1, table 1, Sutherland, 1969*b*).

Source and Age

The source is problematical. A couple of north-westerly trending decomposed dykes, with silicified and pyritised contact zones, cut Permian strata on West Arm, between Boatscrew and Soldiers Points. These dykes may have fed the flow, but the lack of basalt in the immediate vicinity, with intrusive Jurassic dolerite nearby at Anchor Point, suggests that they more probably relate to the dolerite. It is possible the source was located in the middle Tamar near East Arm, where pebbles of identical basalt in sub-basaltic gravels suggest its original extension into this area.

The basalt was erupted following dissection of the underlying Eocene beds. This disconformity probably correlates with the Middle-Upper Eocene disconformity in similar beds in Bass Strait and south-western Victoria (Bock and Glenie 1965; Esso Exploration Australia Inc. 1966). No soil of any magnitude was observed developed on the sediments immediately below the basalt in exposures, or in bore cores (E. D. Gill pers. comm.). This infers that the basalt is not much older than the dissection of the sediments, and is probably Upper Eocene in age, or younger.

A Lower Tertiary age for the basalt is also indicated in the middle Tamar. Here, the gravels with pebbles apparently derived from the flow, as well as a basalt remnant correlated with the upper flow in the lower Tamar, are disconformably overlain by coarse basalt of probable Upper Oligocene or Miocene age.

UPPER OLIVINE-BASALT

This basalt resembles the lower basalt in the field, but outcrops less extensively and shows some petrological differences in thin sections. In the Bell Bay-Point Effingham area it overlies the lower flow and interbasaltic sediments at elevations between 80-100 feet and is at least fifteen feet thick. At Inspection Head it appears to overlie the lower basalt at an elevation of 50-70 feet and outcrop inland to elevations of about 100 feet. Similar basalt is found between the Inspection Head and Beauty Point wharves at river level, with no evidence of the lower basalt, but this is a zone of major landsliding, and large scale downward movements may be involved rather than a channel filling.

Petrology

In thin sections (15 slides, fig. 4) the upper basalt resembles the lower basalt, but the olivine ($2V_z$ 88-98° Fo_{91-72}) is mostly unaltered and a darkish mesostasis replaces the interstitial feldspar, carbonate and clay. The mesostasis contains skeletal crystallites and acicular sheaves of augite, plagioclase crystallites and long slender laths of iron ore, and may be quite dark with globules of iron ore. The augite margins tend to faint mauve tints, particularly in the mesostasis, and are probably slightly titaniferous. Most sections show some brownish green opal and chalcedony, sometimes with carbonate.

Minerals lining amygdales and veinlets in the rock above Inspection Head include chabazite, apophyllite, phillipsite, calcite, siderite, and rare natrolite.

The rock is a nearsaturated alkali olivine-basalt with a fairly high iron oxide content (Analysis 2, table 1, Sutherland 1969*b*), and the excess iron ore presumably gives the dark mesostasis.

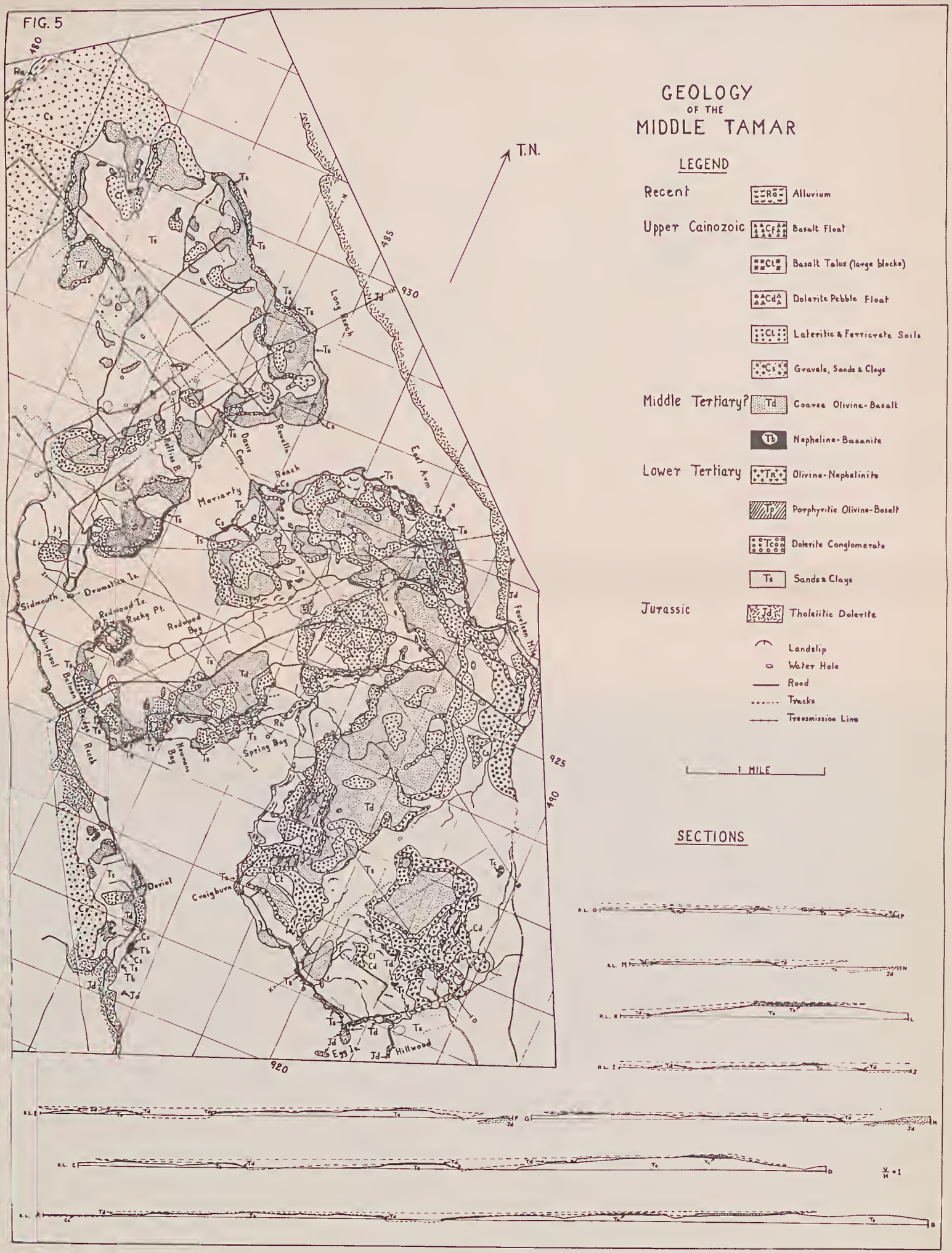

Fig. 5. Geological map and sections, Middle Tamar area.

FIG. 6

Fig. 6. Map of basal contours on basalt, Middle Tamar area.

Source and Age

The basalt is correlated with a porphyritic variety of similar basalt at East Arm in the middle Tamar, suggesting eruption from a plug in that locality. The basalt disconformably overlies the lower flow (post- Eocene?) and inter-basaltic sediments, and its porphyritic correlate is disconformably overlain by coarse basalt of probable Upper Oligocene or Miocene age. This suggests a probable post- Eocene or Oligocene age.

The eruption of lavas into the lower Tamar by the Lower Tertiary may have diverted the Tamar out of its valley, just north of Beaconsfield, into the wide valley between West Head and Badger Head. Gaps in bedrock outcrop, and Tertiary sand and gravel deposits (dipping at over 30° N.E., two miles S.W. of Beaconsfield; Green 1959), along this line may mark an old channel, but detailed stratigraphical and geomorphological work is required to prove this. There is certainly a pronounced westward swing in the old Tamar course, preserved by the younger coarse basalt, at the north end of Long Reach in the middle Tamar (fig. 6). Rediversion of the Tamar from such a course to its present one could have resulted from out pouring of this later lava, or from later downstream breaching of the basalt barrier.

MIDDLE TAMAR

Extensive lava disconformably overlies Lower Tertiary sediments in the middle Tamar (figs. 5 and 6). Four distinctive types are recognised.

PORPHYRITIC OLIVINE-BASALT

This forms a small outcrop at East Arm (8700E - 2700N) at about 250 feet elevation, below the coarse basalt capping the hill. The exposure dips north, with cooling columns dipping south at about 45°, and either represents a remnant of a valley fill or a plug.

Petrology

Thin sections (five slides, fig. 6) show glomeroporphyritic and microporphyritic olivine, plagioclase and augite in a groundmass of plagioclase, augite, olivine and iron ore, interspersed with darkish mesostasis (plate 2, Sutherland 1969*b*).

Olivine (6-13%; 4 mm. max.; $2V_z$ 88-101° $\simeq Fo_{90-64}$) is corroded but fresh, and plagioclase (29-38%; 2.5 mm. max.) is zoned labradorite ($\simeq Ab_{40-54}$). Pale brown augite (26-31%; 1.5 mm. max., mostly 0.1-0.5 mm.; $2V_z$ 58°, z:c 45-46°) tends to form separate aggregates or clusters around olivine and plagioclase. The mesostasis (up to 21%) closely resembles that described in the upper olivine-basalt, Lower Tamar, and contains occasional zeolite cores. In most slides the phenocrysts tend to grade into the groundmass, except from near the basalt contact (325) which shows a much finer grained and distinct groundmass.

The rock is a near saturated alkali olivine-basalt (Analysis 3, table 1, Sutherland 1969*b*). It resembles a porphyritic variety of the upper olivine-basalt in the lower Tamar, and shows higher alumina, lime and soda, and lower magnesia and iron oxide; this presumably reflects the greater plagioclase content of the rock.

Source and Age

The texture of the rock suggests relatively slow cooling near or within a vent. It disconformably overlies Lower Tertiary beds and is disconformably overlain by coarse basalt of probable Upper Oligocene-Miocene age. It is tentatively correlated with the upper olivine-basalt flow downstream in the lower Tamar.

OLIVINE-NEPHELINITE

A small flow of olivine-nephelinite outcrops north-east of Spring Bay at elevations of between 100 to 200 feet. It is up to 50 feet thick and fills a small south trending valley cut in Lower Tertiary sediments. The rock is dense, contains small peridotite xenoliths up to three inchhes across, and is strongly weathered to reddish lateritic kraznosem soils. A coarse pegmatitic variety is developed at 8609E - 2550N.

Petrology

Thin sections (eleven slides, fig. 6) show sporadic peridotite xenoliths amongst olivine, augite, iron ore and apatite, set in a feldspathoidal groundmass (plate 3, Sutherland 1969*b*).

The peridotite xenoliths consist mostly of coarse allotriomorphic olivine ($2V_z$ 86-96° ~Fo_{94-76}; mostly $2V_z$ 88-92°, β 1.667-1.678± 0.002, ~Fo_{91-86}), with some colourless clino-pyroxene ($2V_z$ 67°, Z:c 50°, β 1.690-1.692± 0.002), ortho-pyroxene (sometimes resorbed or with exsolved clino-pyroxene), calcic plagioclase (~Ab_{10}) and greenish-brown spinel. There are rare xenocrysts of clino-pyroxene, mantled with titan-augite (228), and rare zoned feldspars (272). Accidental xenoliths of fused feldspathic sediment(?) are partially or completely replaced with ingrown prismatic augite (271, 272, 282, 286, 315).

Olivine (12-21%) in the rock includes crystals with strain polarisation and translation lamellae, probably derived from the peridotite xenoliths. Truly phenocrystic, euhedral olivine ($2V_z$ 92-98° ~Fo_{84-72}) is mostly less than 1 mm. in size. Pale mauve, zoned, pleochroic titan-augite (29-41%, Z:c 45-58°) forms small prisms and rosettes, rarely exceeding 0.5 mm. Iron ore (5-9%) occurs in squarish to irregular grains and aggregates (0.6 mm. max., mostly to 0.2 mm.), and apatite (2-5%) forms coarse to slender prisms (1.5 mm. max.).

The mesostasis varies from a hyalopilitic colourless to cloudy glass to a groundmass of nepheline (up to 25%), alkali feldspar (up to 15%), and a microlitic mesostasis containing acicular crystallites and some indeterminate chloritic(?) material. It is extremely fine-grained in some sections (272, 286, 315) with uneven cloudy dustings of iron ore, but in others (228, 271, 273) it forms poikilitic potassic nepheline (to 2.5 mm.) and a strongly zoned interstitial potassic feldspar (orthoclase?, to 1.5 mm.). Minor zeolites include stilbite and phillipsite (?) and ovoid amygdales to 1 mm. across include analcime(?) and clay. A late-stage vein, 2 mm. wide with diffuse margins (277), contains numerous biotite flakes (to 0.5 mm.), some prismatic, strongly pleochroic titan-augite, and acicular apatite, in a fine grained nepheline-glass base.

Pegmatitic nephelinite

The coarse pegmatitic variety lacks olivine and contains titan-augite and nepheline (6 mm. max.) in graphic to arborescent intergrowths, with an abundant microlitic mesostasis (plate 4, Sutherland 1969*b*).

The titan-augite is strongly colour zoned (X mauve, Y reddish-mauve, Z yellow-brown, $Y>X=Z$; $2V_z$ 41°_{core}——70°_{rim}, Z:c38-48°_{core}——$48-56^{\circ}_{rim}$, some paler edged crystals with Z:c52$^{\circ}_{core}$——46°_{rim}). Some grades or alters marginally to aegirine-augite (Z:a46$^{\circ}_{core}$——18°_{rim}). Squarish, skeletal and lath-like crystals of ilmenite or titano-magnetite (to 1.2 mm.) are largely altered to leucoxene.

The mesostasis consists of crystallites and radiating sheaves of zoned alkali feldspar laths (to 4 mm.), some acicular aegirine-augite, apatite, chloritic(?) material and zeolites. Amygdales, up to 2 mm. across, include analcime, radiating fibrous zeolite (gonnardite?), stilbite and phillipsite(?).

The olivine-nephelinite is a strongly under saturated alkaline rock (Analysis 16, table 1, Sutherland 1969*b*); the pegmatitic nephelinite presumably increases in silica, soda and potash, and decreases in magnesia.

Source and Age

The pegmatitic nephelinite may mark the approximate position of the vent for the flow; such phases are found in probable vents elsewhere in Tasmania, as at Shannon Tier (Edwards 1950) and at Scottsdale (Marshall *et. al.* 1965).

The flow post-dates dissection of the Middle Eocene sediments and probably also post-dates the nearby inter-volcanic gravels, as these lack any fragments of the rock. Its lateritised surface appears to extend below the base of the adjacent coarse basalt of probable Upper Oligocene-Miocene age, suggesting an older residual and a probable Oligocene or early Miocene age.

NEPHELINE-BASANITE

Outcrop of this rock is confined to the shore, ½ mile south of Deviot Yacht Club, where it overlies Lower Tertiary sediments. It is massive, at least ten feet thick, with a fine grained amygdaloidal margin grading into coarser rock, and contains rare small peridotite xenoliths.

Petrology

Thin sections of the fine grained rock (392, 583, 584, 586) show olivine phenocrysts in a ground mass of plagioclase, augite, some olivine, iron ore, apatite and a feldspathoidal zeolitic mesostasis (plate 5 Sutherland 1969*b*).

Olivine (18-20%; 2.2 mm. max., mostly to 0.5 mm.; $2V_z$ $87-102^{\circ}\simeq Fo_{92-62}$) is slightly altered to serpentine, and includes some interlocking grains showing translation lamellae. Rare corroded augite phenocrysts (to 2 mm.; $2V_z$ $55-65^{\circ}_{core}$——$49-52^{\circ}_{rim}$, Z:c37°_{core}——44°_{rim}) are overgrown with titan-augite, similar to that of the intergranular groundmass grains (27-30%; 0.6 mm. max., mostly to 0.2 mm.). Labradorite (22-29%) forms laths and zoned anhedral plates (to 1 mm., 0.6 mm. av.) Idiomorphic and skeletal iron ore (7%, to 0.8 mm.) moulds and encloses groundmass grains. Apatite is prominent as coarse prisms (to 0.8 mm.) and small needles in the mesostasis. The base is a clear glass containing nepheline (up to 8%), analcime and other zeolites, and scattered biotite flakes. Numerous round amygdales (0.2 - 2 mm.) contain stilbite(?) and other zeolites.

Thin sections of the coarser phase (390, 393, 585) show a coarse olivine-basalt containing olivine (25%; $2V_z 92\text{-}102^\circ$-$Fo_{84\text{-}62}$), with a sub-ophitic to ophitic intergrowth of titan-augite, plagioclase and iron ore, and a microlitic mesostasis. The titan-augite (2.5 mm. max.; $2V_z 71^\circ_{core}$——77°_{rim}, Z:c $48\text{-}54^\circ_{core}$——$48\text{-}65^\circ_{rim}$)is strongly colour zoned, sometimes showing deeper coloured cores and sometimes deeper coloured margins. The labradorite (1.8 mm. max.) is zoned from about Ab_{37} to more sodic compositions and is mantled with alkali feldspar. The mesostasis consists of small laths and curved to spherulitic microlites of alkali feldspar, apatite prisms, grains and crystallites of iron ore, biotite flakes and a zeolitic base containing analcime, spherules of radiating zeolite and little or no apparent nepheline.

Analyses of the fine and coarse phases of the rock (analyses 14 and 15, table 1, Sutherland 1969*b*) are similar, but the coarse phase is slightly richer in silica and poorer in soda, which probably accounts for the disappearance of modal nepheline.

Source and Age

The outcrop suggests a small extrusion with a nearby source, possibly about the small exposure of coarse rock at low tide level, near apparent intersection of faults.

The rock post-dates dissection of underlying Lower Tertiary sediments. Its precise age is uncertain, although it appears to underlie the nearby outcrops of coarse basalt of probable Upper Oligocene-Miocene age.

COARSE OLIVINE-BASALT

This basalt outcrops extensively to elevations of about 600 feet, forming cliffs a hundred feet high north of Craigburn, and drilling has proved it to at least 99 feet below mean river level (Maunsell and Partners 1959-1962). Contours on the base (figs. 5 and 6) give pre-basalt valley sides sloping from about one in ten to about one in two or steeper along the central channel, and a maximum basalt thickness around 400 feet. There is no positive evidence for multiple flows or any significant faulting of the basalt, but poor exposures and blanketing by talus and landslips obscure detailed relationships between outcrops. Sedimentary horizons in the basalt in the bores at Long Reach (Maunsell and Partners 1959-1962), and Whirlpool Reach (Tasmanian Department of Public Works 1957) can be accounted for by landslip movements, clastic dykes and intricate partly intrusive contacts, as detailed later. Petrological variations observed in thin sections are all reconcilable with possible natural variation, including differentiation, within a thick flow.

The basalt is generally massive, medium grained and bluish-grey when fresh, but is strongly weathered and decomposed in some exposures and contact zones. Chilled contacts are generally absent and a relatively large grain size is commonly maintained up to the contact. Irregular patches and veins of coarse pegmatites cut the rocks at Long Reach, Rowella, East Arm, and on the plateau above Craigburn (fig. 6, plate 4). Peridotite xenoliths are present along the western shore of East Arm.

There are sporadic veins, patches and amygdales carrying deuteric and secondary minerals. Amygdales exposed in the quarry, ½ mile north of Craigburn, range to three inches across and release watery fluid when broken open. Most contain either chabazite, or translucent, botryoidal, fibrous linings of thomsonite, sprinkled with small radiating spherules

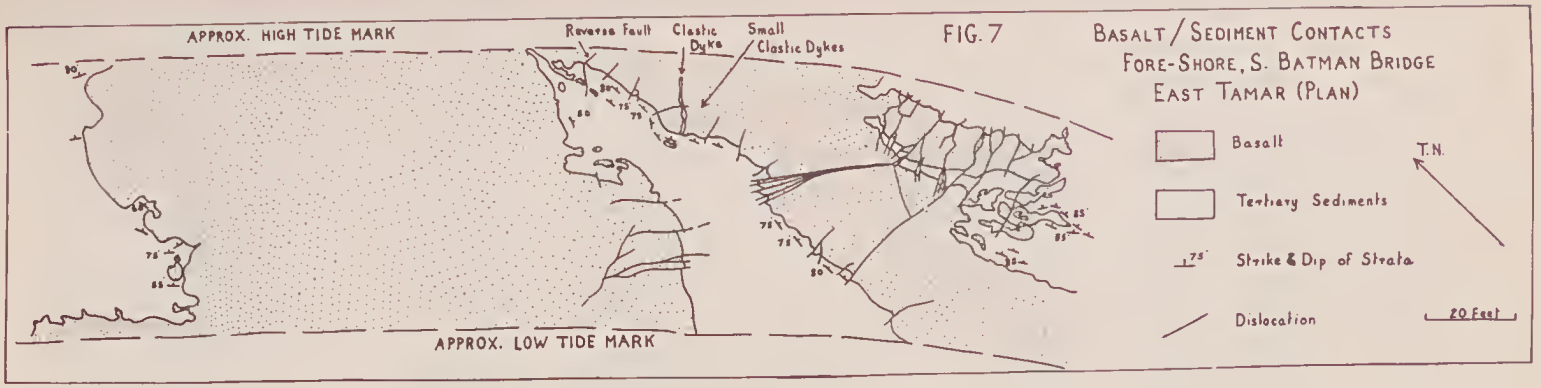

Fig. 7. Diagram of basalt-sediment contacts, Whirlpool Reach.

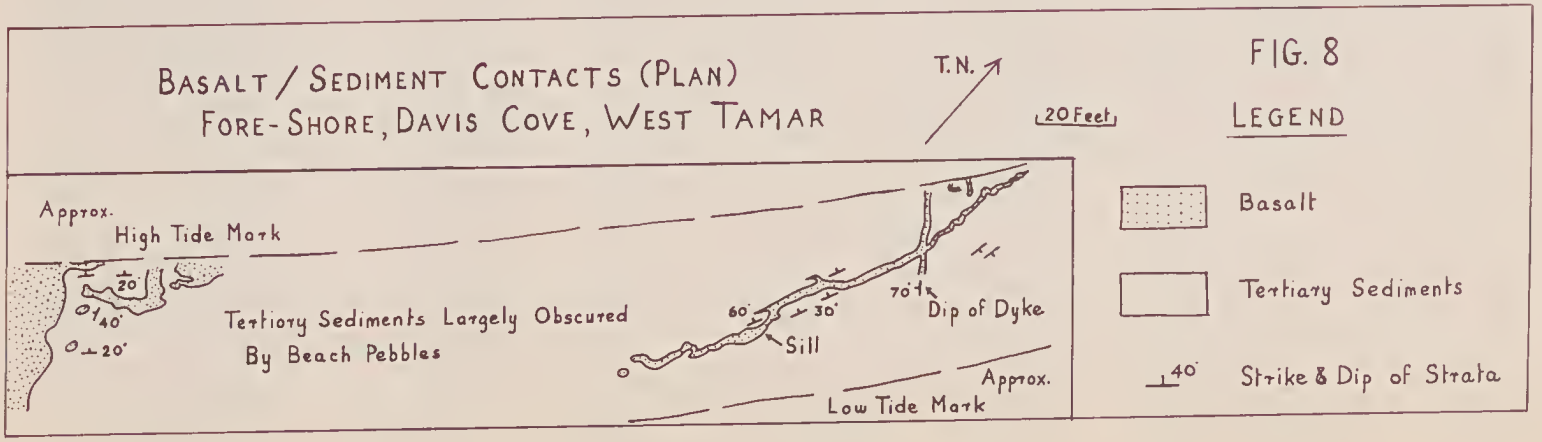

Fig. 8. Diagram of basalt-sediment contacts, Davis Cove, Moriarty Reach.

of gyrolite, and there is rarer apophyllite and calcite. Spherules and linings of zoned radiating zeolite (scolecite, thomsonite and gonnardite?) are common in amygdales in the basalt elsewhere.

Close, platy jointing is developed near basalt contacts at East Arm (8422E - 2756N), Moriarty Reach (8467E - 2631N), Long Reach (8330E - 3011N) and Whirlpool Reach (8441E - 2303N), and passes up into blocky rectangular and irregular jointing. Blocky jointing commonly develops both normal and parallel to the basalt base, and is inclined in dipping contacts on the Batman Bridge Road (8663E - 2660N), Redwood and Drumstick Islands, and on Rowella shore. Close, vertical jointing on the top of the basalt capping north of Hillwood (fig. 6) is interpreted as a remnant of the upper zone of the flow. Polygonal cooling columns occur in a number of places and north of Craigburn (8700E - 2325N) they form inverted fan structure. Small north-westerly and westerly trending fractures dislocate the basalt on the shore south of Batman Bridge, with movements of up to about a foot (fig. 7; plate 7).

Baking at basalt contacts is generally slight, but along the central channel clays may be baked and blackened up to a couple of feet from contacts. Small prismatic cooling columns up to six inches long occur in baked buchitic clay at Long Reach (8345E - 2980N), and minor chert hornfels occur at East Arm (8800E - 2624N) and Moriarty Reach (8395E - 2744N).

Steep contacts exposed on the Tamar shores are often extremely irregular. Pillow-like lobes, dykes and a thin sill, with baking on both contacts and irregular flame-like structures, break the sediments on the shore at Davis Cove (fig. 8). The basalt in these bodies is decomposed and scoriaceous, with more coarsely scoriaceous interior zones, and the enclosing sediments show steep dips suggesting concomitant tilting or slumping. Numerous pillow-like structures are exposed on contacts along the shore south of Batman Bridge (fig. 7), associated with contorted and near vertical sediments (plates 6 and 8). These include near isolated "pillows" showing necking and sometimes small secondary lobes (plates 6 and 10). Irregular contacts also occur along Long Reach (8425E - 2923N; 8299E - 3045N) and Spring Bay (8545E - 3342N). These intrusive bodies are not necessarily feeders themselves, but may be merely localised intrusion from the passage of lava over unconsolidated and water-saturated sediments.

Thin, clastic veins of friable sandstone, up to six inches wide, cut the basalt and infill cores in some of the "pillow" bodies on the shore south of Batman Bridge (plates 9 and 10); the derivation of the sediment is not clear in these exposures. Similar clastic veins associated with part-intrusive contacts at Spring Bay (8545E - 2342N) appear to have intruded up from the underlying sediments.

Petrology

In thin sections (63 slides; fig. 6) the basalt is generally medium grained, with some coarse grained pegmatites, but in a few sections from near contacts it grades into fine grained rock. The basalt contains olivine, plagioclase, augite, iron ore and apatite, with a feldspathic and zeolitic mesostasis. Textures range from porphyritic and intergranular to subophitic and intersertal (plates 6 and 7, Sutherland 1969*b*). Peridotite xenoliths in the basalt at East Arm (199) consist mainly of coarse interlocking olivine ($2V_z$ 86-96° ≈Fo_{94-76}; mostly $2V_z$ 88-92°, β1.669-1.678 ± 0.002, ≈Fo_{91-86}) with strain polarisation and translation lamellae, and some partly resorbed clino-pyroxene ($2V_z$ 53°, Z:c 46°, β1.688-1.690 ± 0.002).

Corroded olivine (4 mm. max., $2V_z$ 86-102°, Fo_{94-62}) forms 9-35% of the basalts, with olivine rich varieties grading to picrites, but the majority of slides carry 15-25% olivine. It is glomeroporphyritic in sections with intergranular groundmass, but this is masked in sections with coarser sub-ophitic to ophitic fabric. It shows some alteration to serpentine, or "bowlingite," and may include iron ore. Larger crystals commonly show translation lamellae and are probably derived from disaggregation of peridotite xenoliths.

Augite (24-38%) forms colourless, glomeroporphyritic, corrosion riddled crystals ($2V_z$ 53°, Z:c 48°) in some slides (168, 169, 192, 193, 223, 224, 230, 330), but generally it is titan-augite forming intergranular prisms and grains (to 0.5 mm.) or subophitic to ophitic plates (to 3 mm.). The titan-augite (X mauve, Y reddish-mauve, Z fawn, Y>X=Z) shows weak to marked colour zoning and pleochroism. Colours are mostly stronger in outer zones and are most marked in sections with coarse sub-ophitic to ophitic textures, or, if intergranular, in association with an abundant microlitic mesostasis. There is considerable variation in optic axial and longitudinal extinction angles, and numerous measurements generally showed increase in $2V_z$ and Z:c from crystal cores to rims. Small pale intergranular grains gave $2V_z$ 73-78° and Z:c 42-52°$_{core}$——48-55°$_{rim}$; small to medium sized grains with moderate to deep colour gave $2V_z$ 50-57°$_{core}$——58-71°$_{rim}$ and Z:c 39-47°$_{core}$——45-61°$_{rim}$; and large plates with moderate to deep colour gave $2V_z$ 54-67°$_{core}$——62-71°$_{rim}$ and Z:c 42-55°$_{core}$——46-60°$_{rim}$. The titan-augite may grade or alter marginally to aegirine-augite, particularly in contact with the mesostasis.

Laths and plates of labradorite (20-48%; 4 mm. max.) are zoned from about Ab_{38} to Ab_{50}. Iron ore (6-11%; titano-magnetite or ilmenite, commonly altered to leucoxene) forms skeletal crystals, irregular masses and laths (to 1 mm.). Apatite (2-4%) is present as coarse prisms (to 0.7 mm.).

The mesostasis forms up to 32% of the rocks and four gradational types are distinguished. Mesostasis type 1 (15 slides) consists of intersertal sodic plagioclase containing small prisms and crystallites of titan-augite (commonly altered to soda-pyroxene), biotite flakes, apatite needles, grains and globules of iron ore, some zeolite and clear glass. Mesostasis type 2 (26 slides) is similar, but interstitial zeolites predominate, may become particularly abundant (168, 169, 223, 232, 330, 396), and include analcime, potash analcime, and fibrous radiating zeolites. In sections with this mesostasis iron ore tends to be idiomorphic and separated from it, and titan-augite, if intergranular, shows only faint colour and pleochroism.

Mesostasis type 3 (19 slides) consists of numerous small laths and curved to spherulitic microlites of alkali feldspar, apatite prisms, grains and crystallites of iron ore, biotite flakes and a zeolitic, analcime-rich base with greenish indeterminate chloritic(?) material. It is abundant in some sections (170, 184, 220, 237, 250, 252, 289, 292, 413) where it contains skeletal titan-augite and prominent thin laths of iron ore. Mesostasis type 4 (3 slides) resembles type 3, but lacks the greenish material and grades into type 2. Mesostasis types 3 and 4 invariably associate with deeply coloured titan-augite.

The distribution of mesostasis type, in association with groundmass texture in the rocks (fig. 6), shows no consistent pattern, although mesostasis type 3 tends to prevail in the lower profiles, within the

main basalt channel.

The coarse basalt ranges from under saturated to near saturated alkaline compositions (analysis 4-6, table 1, Sutherland 1969*b*). The picritic type (analysis 5) is richer in magnesia and poorer in silica and alumina compared with the more feldspathic and mesostasis-rich types (analysis 4 and 6). Extreme types of the basalt include porphyritic and pegmatitic varieties described below.

Porphyritic olivine-basalts: Basalt from Spring Bay (8544E- 2341N) in section (171) shows phenocrysts of olivine and plagioclase (2 mm. max.) grading into a fine grained groundmass of plagioclase, pale augite, iron ore, apatite and zeolite. The plagioclase is zoned from labradorite to andesine and subophitically intergrows and poikilitically encloses groundmass minerals. Small scattered inclusions of sediment (?) are replaced with minute clino-pyroxene grains, with apparent corona structure.

The texture suggests chilling of the rock as normal crystallisation was proceeding. The rock is from a part-intrusive contact of the coarse basalt, and this suggests quick cooling where a lava tongue entered the underlying, probably wet, sediments.

Pegmatitic veins: A pegmatitic vein, in coarse picritic basalt from East Arm shore, in sections (197, 198) shows irregular margins up to 7 mm. wide bordering the interior of the vein. The margins are composed of stout zoned labradorite crystals that include apatite and ophitically intergrow with titan-augite, skeletal iron ore and olivine. The titan-augite is strongly colour zoned ($2V_z$ 67-74°$_{core}$——74-84°$_{rim}$, Z:c 35-51°$_{core}$——43-66°$_{rim}$). Olivine ($2V_z$ 100-105° Fo_{65-55}) is sparse, more favalitic than in the host rock, and tends to be altered to "bowlingite" and replaced marginally by iron ore. Small amounts of mesostasis (type 2) are present. The minerals (to 2.5 mm. long) show slight alignment normal to the vein margins. The interior of the vein is up to 12 mm. wide and is largely mesostasis (types 3 and 4) containing sporadic smaller crystals of the margin minerals.

Pegmatitic basalts: These form patches to over eight feet across in the coarse basalt. Thin sections (191, 328, 409, 658) from pegmatite above Craigburn (8767E - 2435N) and on Long Reach shore show coarse ophitic and dendritic intergrowths of plagioclase, titan-augite, olivine and iron ore, with an analcime-rich mesostasis (plate 8 Sutherland 1969*b*).

Olivine (10%; 7 mm. max.; $2V_z$ 100-105°-Fo_{65-55}) forms late intergrowths to deeply corroded crystals rimmed with iron ore. Labradorite in laths and plates (36%; 9 mm. max.) is zoned from about Ab_{38} to more sodic compositions and is overgrown with alkali feldspar (up to 16%). The overgrowths are mostly less than 0.5 mm. wide and are riddled with inclusions and graphic intergrowths of pyroxene, iron ore and apatite. Large plates of titan-augite (21%; $2V_z$ 65-71°$_{core}$—— 67-79°$_{rim}$, Z:c 33-62°$_{core}$—— 38-64°$_{rim}$) are strongly colour zoned, mostly with deeper coloured outer zones, but sometimes with paler margins. Aegirine-augite is a common marginal alteration on titan-augite and also forms slender inclusions in the alkali feldspar overgrowths. Iron ore (9%) forms some early idiomorphic crystals, but mostly occurs in large laths and skeletal masses to 5 mm. long, intergrown with and moulded on other minerals. Coarse apatite prisms reach 2 mm. in length.

The mesostasis resembles type 3; it contains analcime cores, up to 1 mm. across, and rare olivine grains completely altered to serpentine.

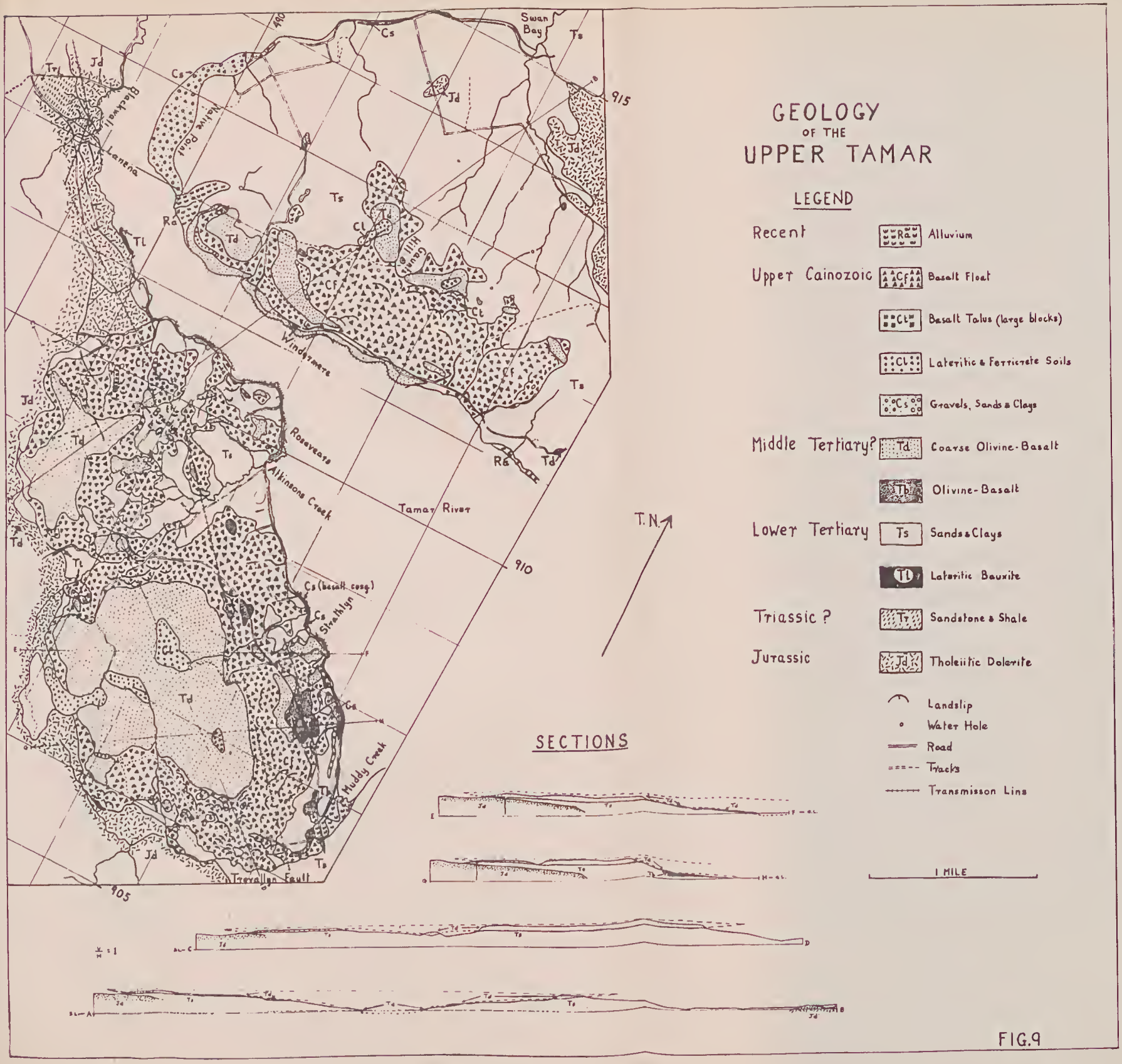

Fig. 9. Geological Map and sections, Upper Tamar area.

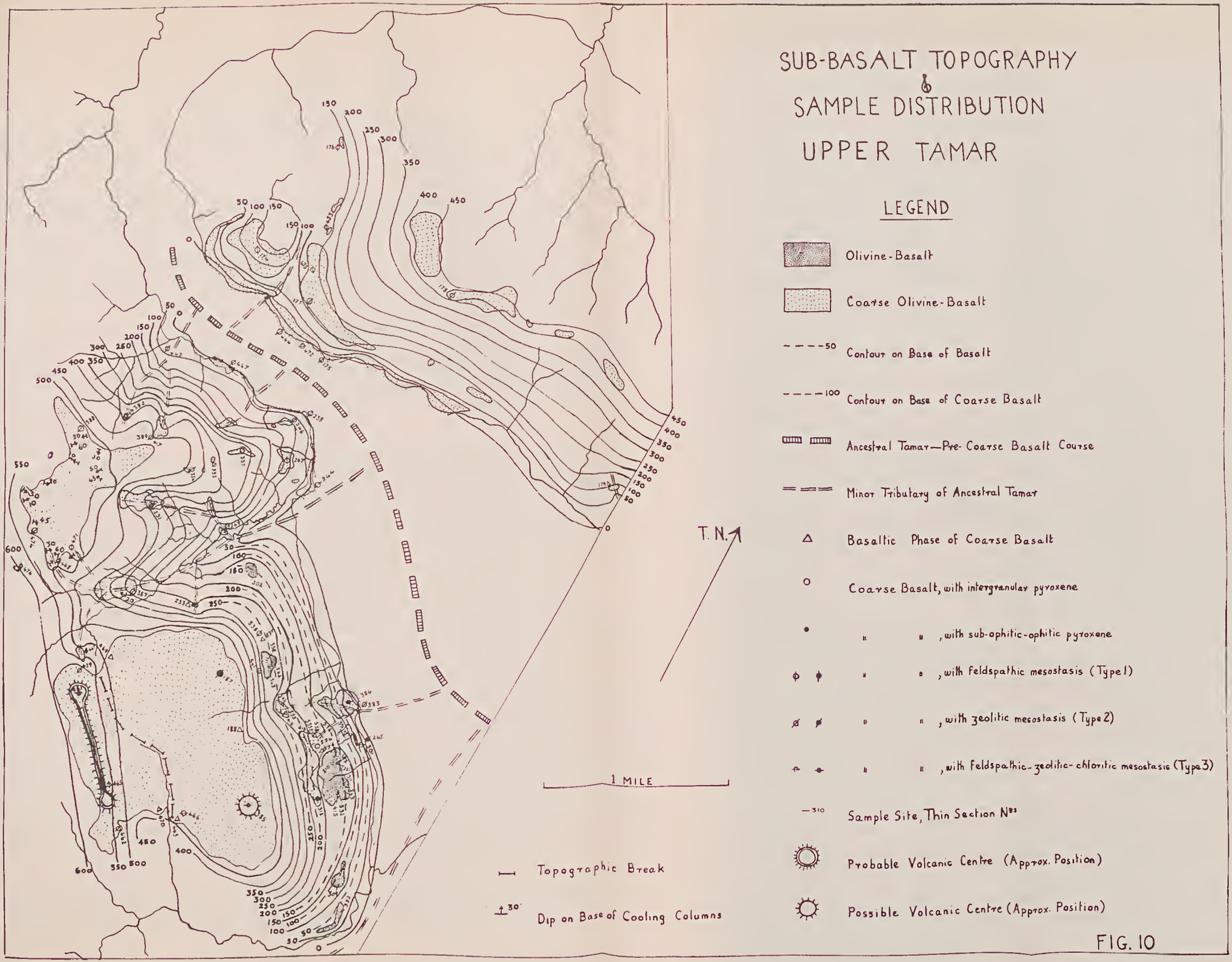
SUB-BASALT TOPOGRAPHY
&
SAMPLE DISTRIBUTION
UPPER TAMAR
LEGEND
Olivine-Basalt
Coarse Olivine-Basalt
50 Contour on Base of Basalt
100 Contour on Base of Coarse Basalt
Ancestral Tamar—Pre-Coarse Basalt Course
Minor Tributary of Ancestral Tamar
Basaltic Phase of Coarse Basalt
Coarse Basalt, with intergranular pyroxene
" " , with sub-ophitic-ophitic pyroxene
" " , with feldspathic mesostasis (Type 1)
" " , with zeolitic mesostasis (Type 2)
" " , with feldspathic-zeolitic-chloritic mesostasis (Type 3)
310 Sample Site, Thin Section Nos
Probable Volcanic Centre (Approx. Position)
Possible Volcanic Centre (Approx. Position)
T.N.
1 MILE
Topographic Break
30 Dip on Base of Cooling Columns
FIG. 10

Fig. 10. Map of basal contours on basalt, Upper Tamar area.

Weathered pegmatites in the Long Reach bores contain abundant mesostasis forming over half the rock (328).

The pegmatites are near saturated alkaline rocks (analysis 13, table 1, Sutherland 1969*b*) enriched in silica, titania, soda, potash and phosphate, and impoverished in lime and magnesia, compared with the host coarse basalts.

Inclusions: An alkali(?) feldspar xenocryst, 1 cm. across, in the basalt at 8518E - 2660N, shows fused, glassy corroded borders, cracks and cleavages, largely altered to sericite and zeolites (223). The fused borders, up to 1.5 mm. wide, contain small prisms of colourless clinopyroxene, indeterminate chloritic(?) material, and vughs lined with analcime and radiating fibrous overgrowths, either a zeolite or released silica as lussatite or chalcedony. The xenocryst is surrounded by a dense outgrowth of pale mauve augite ($2V_z 61^\circ$, $z:c 53^\circ$) in prisms up to 1 mm. long.

Basalt in the Long Reach bores contains rare pieces of gritty sandstone up to several inches across. Section (329) shows rounded quartz, clay and rock fragments in a pale brown isotropic matrix, paler coloured along a thin contact zone with the host rock. These inclusions probably represent Tertiary sediment, but they are not strongly indurated and may be clastic veins.

Source and Nature of the Coarse Basalt

The source is not obvious. The general distribution and basal contours (fig. 6) suggest a source under the thick capping north of Craigburn, and pegmatites here may mark an underlying feeder. If lava issued here, then it spilled south, north and west, filling the Tertiary Tamar channel. Alternatively, or in addition, lava may have erupted into the Tamar channel, ascending fault lines controlling the course of the Tamar along Long Reach, Moriarty Reach and Whirlpool Reach. The basalt extends to 100 feet below river level in the Tamar channel and its full depth, yet unproved, may be within throats of feeders.

Whether there was one voluminous outflow or separate outflows is uncertain from the available field evidence, as previously discussed. However, a flow of considerable thickness can account for several features.

1. the rocks show consistently large grain size, even against contacts, suggesting slow cooling in very thick lava.
2. they are closely similar in grain size, mineralogy and textures to coarse basalt at Mt. Cameron West, N.W. Tasmania, apparently a single flow over 500 feet thick (Sutherland and Corbett 1967).
3. they show variations in modal mineralogy and chemical composition compatible with some differentiation in a thick lava (Sutherland 1969*b*).
4. numerous pegmatites, indicating considerable volatile-rich residual fluids, are most abundant in the central channel; this suggests slow cooling within lower levels of a thick lava column. Overwhelming of an old watercourse of the Tamar with a sufficiently large volume of lava could incorporate water, without marked chilling or vesiculation by steam loss, except in relatively thin off-shoots intruding underlying sediments at contacts. Slow cooling and accumulation of residual fluids would also be likely within the throats of any underlying feeders.

The central channel occupied by the coarse basalt (fig. 6) probably represents an old channel of the Tamar, cut to well below present sea-level. However, the possibility that it is largely or in part an intrusive structure of elongate feeder channels must be borne in mind.

Formation of the basalt channel by major downwarping subsequent to extrusion is considered unlikely, as underlying sediments along the contacts dip out from the channel margins, but there may have been some contemporaneous slumping, dragging, or downsagging of sediments and lava.

Influence on Drainage

Remarkably, no major lateral or upstream diversion of the Tamar is apparent from this massive basalt effusion. This is probably explained by downsagging of the lava surface along the main channel filling, either from concomitant slumping of underlying sediments, and/or slow cooling within the channel allowing lava to drain away along this zone. When the river, dammed upstream, overtopped the basalt barrier, it would follow such surface downsags and superimpose over the basalt channel.

Alternative explanations require separate extrusions, laterally shifting the Tamar finally back to its original position, for which there is yet no direct evidence, or river capture along Moriarty Reach of one lateral by the other, which still involves superimposition over part of the main basalt channel.

The old Tamar course, preserved under the coarse basalt, turns westwards at the north end of Long Reach (fig. 6), where it may have diverted around the older flows in the lower Tamar, as previously discussed.

Age

The coarse basalt post-dates dissection of Middle Eocene sediments, of inter-volcanic gravels, and of porphyritic basalt at East Arm, correlated with the upper basalt in the lower Tamar, and apparently post-dates lateritisation of the olivine-nephelinite at Spring Bay. These facts suggest considerable erosion of the lower Tamar basalts (post-Eocene-Oligocene?), prior to eruption of the coarse basalt. The lateritic profiles on the coarse basalt resemble those of the Timboon Terrain in Victoria (Gill 1964) suggesting approximate correlation and a lower Pliocene upper age limit.

The channel occupied by the coarse basalt presumably represents an old course of the Tamar, cut following tectonic uplifting and/or major marine regression in Bass Strait. Data on the Bass Strait area (Bock and Glenie 1965; Esso Exploration Australia Inc. 1966; Ludbrook 1967; Sutherland and Corbett 1967; Kershaw and Sutherland unpubl. ms.) suggest that, within the age limits under consideration, such events occurred in Upper Oligocene and in Upper Miocene-Lower Pliocene time. This would give late Oligocene-early Pliocene age limits for the coarse basalt, with its extensive dissection favouring a late Oligocene-early Miocene age.

UPPER TAMAR

Basalts disconformably overlie Palaeocene sediments on both banks of the Tamar (figs. 9 and 10). The oldest appears to be a small flow of olivine-basalt, confined to the west bank, and is succeeded by widespread thick coarse olivine-basalt.

OLIVINE-BASALT

This rock outcrops from elevations of 300 feet down to below 50 feet on the hillslopes between Atkinson's and Muddy Creeks, and is up to

50 feet thick. It is probably more extensive than as mapped, but exposures are obscured by talus and landslips. It is dense, massive, irregularly jointed, dark bluish-grey rock and is strongly weathered in places to reddish soils associated with pisolitic ferricrete.

Petrology

Thin sections (15 slides, fig. 10) contain olivine phenocrysts in a fine grained groundmass of plagioclase, augite, some olivine, iron ore and apatite, with a glassy to zeolitic mesostasis (plate 9, Sutherland 1969*b*).

Corroded olivine (17-26%; 1.9 mm.; $2V_z$ 87-103° Fo_{92-60}) is only slightly altered and some crystals show strain polarisation. Labradorite laths (28-47%; 0.7 mm. max.; Ab_{40}) often show corroded interiors filled with dark glass or inclusions of pyroxene and iron ore. Zoned titan-augite (29-37%; $2V_z$ 58° core ——47° rim, Z:c 43-49° core ——51-54° rim) forms sporadic microphenocrysts and rosettes, in some sections, but is mostly intergranular grains (to 0.1 mm.). Iron ore (5-11%) is scattered as squarish to circular grains (to 0.2 mm.) of titano-magnetite or ilmenite, altered to leucoxene. Apatite (2-3%) forms numerous small needles in the mesostasis.

The mesostasis (up to 28%) is clouded by crystallites of iron ore, incipient analcimisation (?) and slight chloritisation (?), and in extreme cases (310) is strongly charged with iron ore and quite dark. Interstitial and amygdaloidal zeolites include analcime, stilbite and natrolite. Rare, irregular veinlets of mesostasis cut the rock (310), and there are rare small xenoliths of sediment (243) mostly replaced by prismatic clino-pyroxene ($2V_z$ 67° core ——58° rim, Z:c 43° core ——51° rim).

The rock is an under saturated alkali olivine-basalt, approaching a basanite in composition (analysis 7, table 1, Sutherland 1969*b*).

Source and Age

The source is not exposed, but the basalt appears to have flowed east down towards the Tamar from the vicinity of the Trevallyn Fault line. Its age can only be fixed within wide limits; it post-dates dissection of underlying Palaeocene sediments, and its lateritised and dissected surface appears to be overlain by coarse basalt (Pre-Pliocene?).

COARSE OLIVINE-BASALT

This caps much of the area between Rosevears and Muddy Creek, and about Windermere, from elevations of 700 feet on the West Tamar and 500 feet on the East Tamar, down to below river level. The outcrops on the East and West Tamar were probably originally continuous, giving a maximum basalt thickness of about 600 feet. A basalt scarp over 100 feet high is exposed above the southern slopes of Atkinson's Creek. Whether separate flows occur is uncertain, as field relationships between outcrops are obscured by deep dissection, widespread landslipping, and similar petrological characters.

Good exposures of basal contacts are confined to cuts along the upper West Tamar Highway, but these have deteriorated. A steep contact at Brady's Lookout dips about 70° south-west, and underlying sediments are weathered and darkened over a couple of feet from the contact. Baking is slight, with no marked chilling or vesiculation at the basalt margin, and the exposure is probably the head of a small, steep lava-filled valley. Slight baking, with slight chilling and vesiculation, is typical

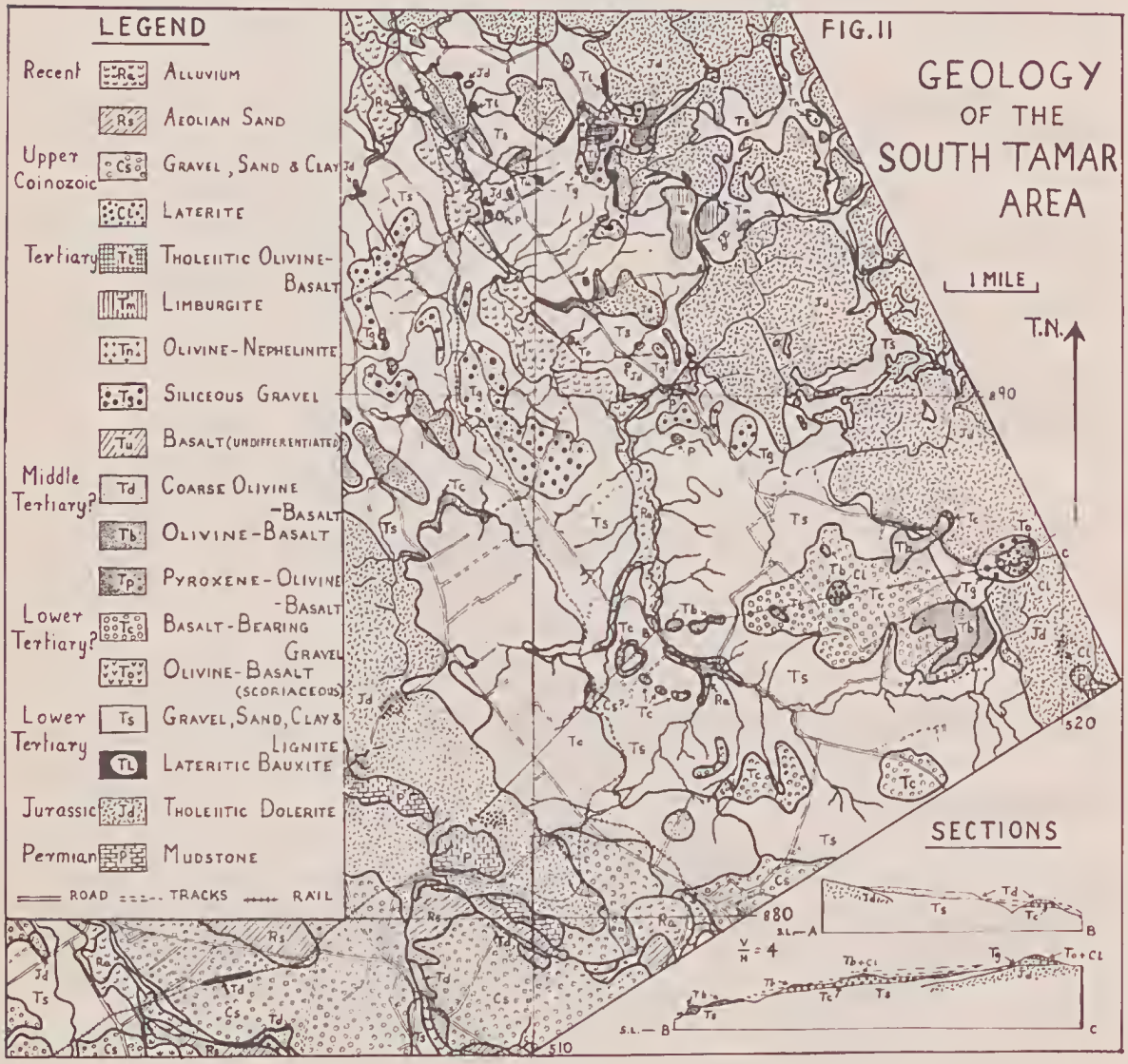

Fig. 11. Geological Map and sections, South Tamar area.

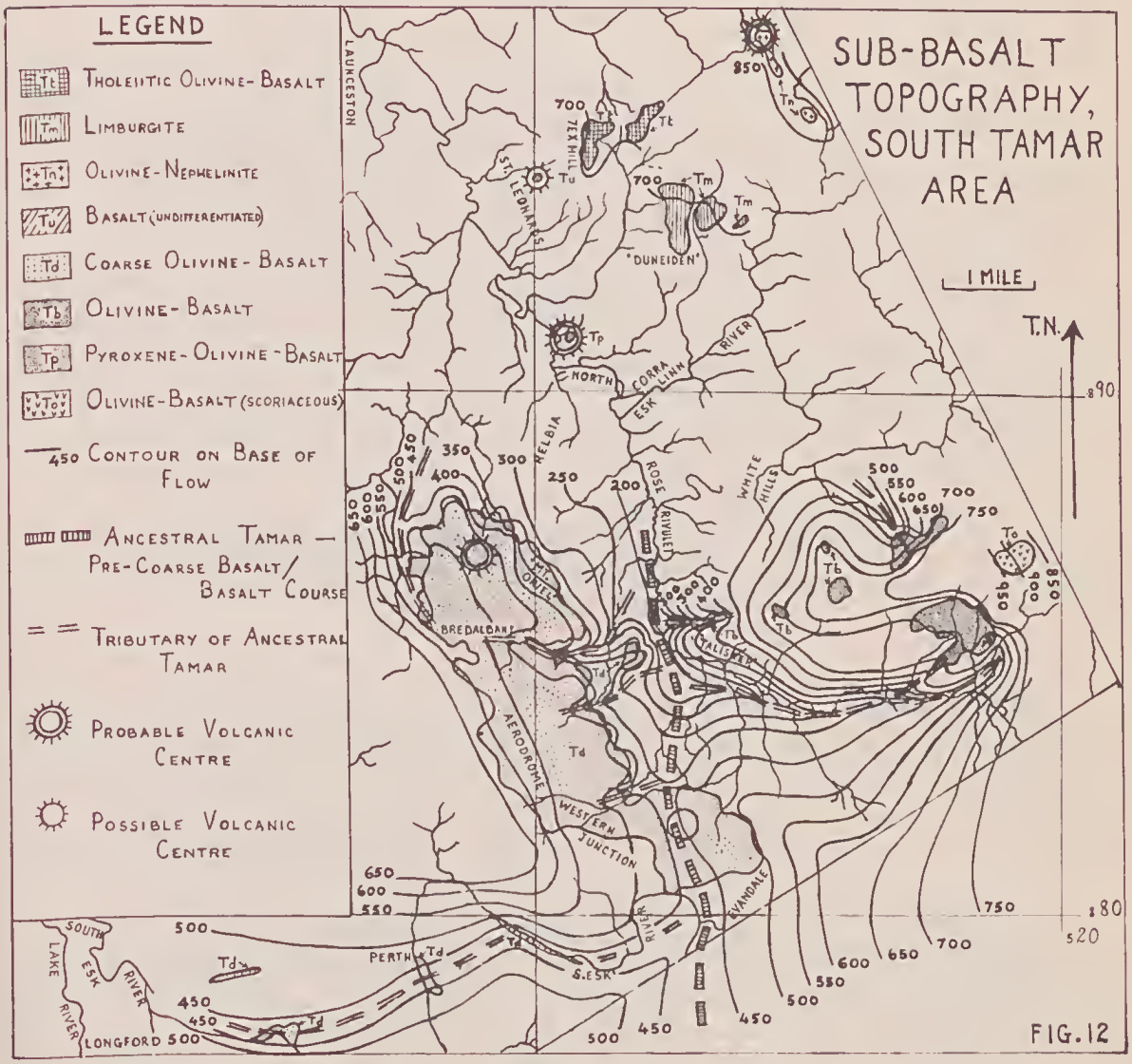

Fig. 12. Map of basal contours on basalt, South Tamar area.

of most contacts, except for some greyish chert hornfels at 9189E - 0633N.

Outcrops resemble the coarse basalt of the middle Tamar, but the rocks become finer grained near contacts; pegmatitic phases are lacking, except on the plateau above Strathlyn (9312E - 0715N). Sporadic, round amygdales near basalt margins contain analcime, natrolite, stilbite(?) and other zeolites. Cooling columns on Brady's Lookout curve down to the basalt contact in the road cut; orientations of cooling columns in this area (fig. 10) indicate that in most cases columns develop normal to the basalt base.

Petrology

Thin sections of the finer grained contact zones (17 slides, fig. 10) resemble those previously described from the underlying olivine-basalt in the Strathlyn area. However, they tend to be slightly more feldspathic and poorer in pyroxene, and lack a cloudy mesostasis and corrosion of feldspar laths. They grade into coarse basalt and a few sections (386, 416) show intermediate porphyritic textures.

The coarse basalts (43 slides) resemble those described from the middle Tamar and show similar variations in the types of mesostasis; the petrology is summarized in fig. 10. Some sections (462, 465, 471) carry pale, glomeroporphyritic augite with partly riddled interiors, and are restricted to the western margin of the basalt. The pegmatites at 9312E - 0715N (385) closely resembles pegmatites from the middle Tamar, with olivine ($2V_z$ 95-105°, β 1.730 - 1.741 ± 0.002, Fo_{77-55}) and titan-augite ($2V_z$ 77°_{core} —— 78°_{rim}, Z:c $45-49^{\circ}_{core}$ —— $52-58^{\circ}_{rim}$, β 1.715 ± 0.002).

The coarse basalt grades into more feldspathic varieties, poorer in olivine, at some of the higher levels. Chemical analysis of such rock shows near saturated alkali olivine-basalt fairly high in alumina and low in magnesia, suggesting a slightly differentiated phase typical of an upper zone (analysis 8, table 1, Sutherland 1969b).

Source and Age

No feeders are exposed. However, more strongly baked sediment at 8189E - 0633N and the appearance of augite phenocrysts in the basalt along its western margin, infers effusion along a line of faulting in this vicinity (figs. 1 and 10). The basalt reaches its highest elevation on this line and a sample from this summit is noticeably enriched in mesostasis (461). Contours on the basalt base (fig. 10) suggest lava spilled from this line east towards Strathlyn and north over Brady's Lookout, filling the old Tamar channel and extending east beyond Windermere.

The coarse basalt below the 300 feet elevation near Strathlyn, on the eastern part of the plateau above the 400 feet level south of Atkinson's Creek, and in the isolated cappings at 400 feet above Windermere, may be separate and later flow or flows. These areas are marked off from the western and northern outcrops by a topographic break (fig. 10) and the pegmatite at 9312E - 0715N may mark an eruptive point, located over the Trevallyn Fault line near the likely centre for the oldest olivine-basalt at Strathlyn.

The precise age of the coarse basalt is difficult to fix. It was erupted following considerable dissection and weathering of the underlying Lower Tertiary sediments. The underlying olivine-basalt at Strathlyn also appears to have been weathered, lateritised and dissected before eruption of the coarse basalt. There is considerable resemblance

to the coarse basalt of the middle Tamar, in occupation of a channel cut to below present river level and in degree of subsequent dissection and development of lateritic profiles. This suggests approximate contemporaneity and hence late Oligocene-early Pliocene age limits.

SOUTH TAMAR

SCORIACEOUS OLIVINE-BASALT

This flow remnant caps a small hill on the Blessington Road, three miles E.S.E. of White Hills at 900-990 feet in elevation. It overlies siliceous waterworn gravels and slopes down to the north-east. The capping is 60-70 feet thick and is largely lateritised scoriaceous basalt, with a deep kaolinised and bauxitised lower profile.

Petrology

Fresh basalt only occurs at road level on the north side, and sections (274, 378) show a vesicular basalt containing olivine in an intergranular to subophitic groundmass of labradorite, augite, iron ore and a little mesostasis.

Corroded olivine (10-12%; 1.3 mm. max.) is heavily altered to ferruginous material. Labradorite (37-43%) forms laths and plates (to 0.9 mm.), zoned from about Ab_{38} to Ab_{54}. Augite (36-39%) occurs in almost colourless, zoned crystals (to 0.7 mm.). Iron ore (5-7%) forms squarish to irregular grains and lath like rods (rarely to 0.5 mm.). The mesostatis (6-11%) is a colourless to pale grey or brown glassy, feldspathic residue, slightly clouded with globules of iron ore.

The rock resembles a near saturated alkali olivine-basalt, but the paucity of fresh rock precludes accurate determination.

Source and Age

The source is unknown, but the basal slope suggests an origin to the west, providing that no later tectonic tilting took place from this direction. The basalt appears to be an old lateritised residual, younger than the Palaeocene-Eocene beds of the area, but older than the inter-volcanic gravels to the west, as these contain fragments of similar basalt. The available evidence thus gives tentative Eocene to mid-Tertiary age limits.

THOLEIITIC OLIVINE-BASALT

Remnants of this flow cap 7EX Hill above St. Leonards, overlying siliceous conglomerates and sands at elevations of about 700 feet. The basalt is 20-30 feet thick, with a scoriaceous base passing up into more massive basalt. Baking of underlying sediments is slight and a petrographic description of a contact sandstone is given in Longman *et. al.* (1966)

Petrology

Thin sections (6 slides) show several variations. Massive basalt (173) contains olivine and plagioclase in an abundant hyaloophitic black mesostasis (plate 11, Sutherland 1969*b*).

Olivine (13%; $2V_z$ 88-99°≈Fo_{91-67}) forms corroded, fresh, glomeroporphyritic phenocrysts and scattered granules (to 1.8 mm.). Labradorite

(33-43%; $\approx Ab_{40}$) forms skeletal laths and plates (to 1.2 mm.). The remainder of the rock is an opaque glass containing numerous elongate crystallites and radiating sheaves of plagioclase and clino-pyroxene, and a little greenish-yellow opal and chalcedony. This rock matches the Ouse Type (Edwards 1950; McDougall 1959) and grades into slightly vesiculated rock.

In this variety (208), olivine (to 2.3 mm.) show slight alteration to opal and carbonate, labradorite laths rarely exceed 0.3 mm. long, and pale granular augite (19-23%; Z:c 44°_{core}——46°_{rim}), is crystallised in the mesostasis (25%). Vesicles contain opal, chalcedony and carbonate, and the rock resembles the Bridgewater and Pontville types (McDougall 1959).

Strongly vesicular varieties (172, 420) are similar, but the dark mesostasis has largely crystallised. These rocks contain olivine (12%), zoned labradorite (39-44%), intergranular to subophitic augite (32-37%), small irregular grains and laths of iron ore (4-6%) and brownish-grey mesostasis clouded with crystallites (4-9%). These approach the Jordan type (McDougall 1959).

The rock is saturated olivine-basalt with low alkalies (analysis 18, table 1, Sutherland 1969*b*), typical of tholeiitic types.

Source and Age

The feeder position is obscure. Basalt 400 feet below 7EX Hill (Longman *et. al.* 1964) was exposed in a swimming pool excavation (Dr. K. Burns pers. comm.). The excavation went through soil, clay, then weathered basalt with fairly regularly shaped joint blocks, and at nine feet passed into clay containing ferruginised fossil tree trunks. No basalt is now visible at the site and its precise relationships to the 7EX Hill flow cannot be determined. However, its restricted occurrence and position makes it a possible eroded feeder for the flow.

The flow overlies Palaeocene-Eocene beds, but other field evidence for its age is lacking.

LIMBURGITE

Small cappings of this rock outcrop above "Duneiden" farm, less than a mile S.W. of the 7EX Hill flow and at a similar elevation of 700 feet. The flow is 20-30 feet thick and is moderately vesicular towards the base.

Petrology

Thin sections (206, 207) show olivine, augite and iron ore in a dark glass (plate 12, Sutherland 1969*b*).

Fresh, corroded olivine (14-19%; 2 mm. max., mostly to 1 mm.; $2V_z$ 88°-$99^{\circ} \approx Fo_{91-67}$) includes some crystals with strain polarisation and translation lamellae. Zoned, prismatic augite (37-42%; to 0.5 mm.; Z:c 44°-49°_{core}——49°-55°_{rim}) shows faint brown to mauve pleochroic margins. The base is hyaloophitic to hyalopilitic purplish-brown glass, containing small squarish grains and lath-like iron ore crystallites (to 0.1 mm.), sporadic pale yellow opal, and vesicles lined with opal and chalcedony.

It is strongly under saturated rock, fairly low in alumina and alkalies (analysis 17, table 1, Sutherland 1969*b*).

Source and Age

The source is unknown, but the close association and similarity in outcrop to the 7EX Hill flow, suggests possible eruption from a related centre. The flow overlies Palaeocene-Eocene sediments, but there is little other field evidence of its age.

OLIVINE-NEPHELINITE

A small flow of this rock overlies Jurassic dolerite and Tertiary sediments, three miles N.E. of St. Leonards, at elevations around 900 feet. The flow is up to 50 feet thick, with laterite remnants. It is dense, bluish-grey, fine-grained rock containing amygdales, and small xenoliths of dolerite and rare peridotite in the cut on the Scottsdale Highway.

Petrology

Thin sections (6 slides) show olivine phenocrysts in a groundmass of augite, olivine, iron ore and a glassy and feldspathoidal mesostasis. Some sections contain rare dolerite xenoliths, pyroxene xenocrysts and peridotite fragments.

Corroded olivine (13-18%; 2.5 mm. max.; $2V_z 86\text{-}97^{o} \simeq Fo_{94\text{-}74}$) shows slight alteration to chloritic and "bowlingitic" materials, and some crystals show strain polarisation and translation lamellae. Titan-augite (37-46%) forms prismatic microphenocrysts and grains (to 0.7 mm.). Iron ore (7-10%) is dispersed as minute squarish to irregular grains (to 0.5 mm.); rare larger clots (to 2 mm.) sometimes show cores of brownish-green spinel (211) and represent altered xenocrysts. Apatite (2-3%) forms elongate prisms (to 0.5 mm.) and minute needles in the mesostasis.

The mesostasis (14-25%) is hyalopilitic glass, slightly clouded in patches with iron ore crystallites, and contains poikilitic areas of nepheline up to 2 mm. across. Amygdales are commonly lined with natrolite. Dolerite xenoliths (to 5 cm.) show mineralogy and textures typical of the Jurassic dolerite bedrock of the area, but the mesostasis is fused to pale yellow or dark brown glass. Rare corroded clino-pyroxene xenocrysts, derived from the dolerite xenoliths, and clino-pyroxene exposed on the edges of xenoliths, are overgrown with titan-augite. The margins of some dolerite xenoliths (339) contain pockets of natrolite and skeletal nepheline (to 0.5 mm.) filled with dark glass.

The rock petrologically resembles some sections of the olivine-nephelinite at Spring Bay in the middle Tamar, and is probably similar in chemical composition.

Source and Age

The eruptive point is probably marked by the occurrence of dolerite xenoliths at the north end of the flow. This point also lies on the projected intersection of north-westerly and north-easterly fault or strong joint lineaments, mapped nearby (Longman *et. al.* 1964).

The flow overlies sediments that probably represent an extension of the Palaeocene-Eocene beds to the west, and it has been lateritised; further field evidence of its age is lacking.

PYROXENE-OLIVINE-BASALT

A small outcrop of this rock overlies Lower Tertiary sediments, be-

tween 100-130 feet elevations, on the bank of the North Esk, 1¼ miles N.E. of Corra Linn bridge. Cooling columns in the basalt incline normal to the base, which dips down towards the river. The basalt is massive, darkish-grey, and is speckled with numerous inclusions which project roughly on weathered surfaces. These are prominently black, vitreous pyroxene crystals to over 2 cm., commonly with reaction borders, and dolerite fragments to over 20 cm., sometimes with small irregular veinlets of fused material on the margins. Rare small peridotite and fused sedimentary xenoliths are present.

Petrology

Thin sections (9 slides) show xenoliths and xenocrysts scattered amongst phenocrystal olivine and augite in a groundmass of plagioclase, augite, olivine, iron ore and a fairly abundant hyaloophitic to intersertal mesostasis (plate 10 Sutherland 1969*b*).

Corroded olivine (11-17%; 0.05-3.5 mm.; $2V_z$ 86-99° Fo_{94-67}) sometimes includes iron ore, and some large crystals show strain polarisation and translation lamellae. Colourless augite (4-11%) forms corroded cores and resorbed borders, with overgrowths of titaniferous augite in euhedral to subhedral crystals (0.5 mm. - 2 cm., but mostly 1-5 mm.). The cores ($2V_z$ 50-56°, Z:c 47-49°, β 1.698-1.700±0.002; analysis 1 and 2, table 2, Sutherland 1969*b*) are more or less optically continuous with the spongy recrystallised borders ($2V_z$ 50-62°, Z:c 44-52°; analysis 3, table 2, Sutherland 1969*b*). The borders reach over 2 mm. wide, contain small inclusions of corroded olivine and rare trains of fresh augite, and sometimes show rough concentric layering due to different degrees of resorption. In smaller crystals the core is generally completely resorbed. The overgrowths, up to 0.4 mm. wide, are composed of the normal augite of the groundmass (analysis 4, table 2, Sutherland 1969*b*). They show narrow zoning, sometimes oscillatory, and a general change from colourless augite on the inside to pleochroic titaniferous augite on the outside. They tend to build out in prismatic extensions and cleavages tend to be continuous across the overgrowth; some show slight corrosion riddling.

Labradorite (24-35%) forms laths and plates (1.5 mm. max., mostly to 1 mm.) zoned from about Ab_{37}. Some laths have slightly hollowed interiors and larger laths show slight flow alignment. Titaniferous augite (26-31%) forms overgrowths, microphenocrysts and rosettes (mostly 0.3-0.5 mm.), smaller groundmass grains, and rare corroded phenocrysts (to 2 mm.) containing inclusions of groundmass minerals. The augite is colour zoned (X, Y mauve, Z brownish-yellow), generally showing more intensely coloured and pleochroic outer zones ($2V_z$ $54\text{-}66^\circ_{core}$ —— $65\text{-}72^\circ_{rim}$, Z:c $45\text{-}54^\circ_{core}$ —— $54\text{-}61^\circ_{rim}$), but sometimes showing paler outer zones ($2V_z$ $59\text{-}66^\circ_{core}$ —— $41\text{-}53^\circ_{rim}$, Z:c $47\text{-}49^\circ_{core}$ —— $41\text{-}42^\circ_{rim}$). Iron ore is dispersed in squarish to irregular grains mostly to 0.05 mm.).

The glassy mesostasis (12-23%) is darkened with crystallites of iron ore and contains sporadic patches of carbonate and zeolites. Late-stage plagioclase plates in the mesostasis enclose augite and apatite needles and intergrow with crystallites along their borders.

Dolerite xenoliths, typical of the Jurassic dolerite bedrock, appear to have partially melted on incorporation, fusing their normal mesostasis. In sections (563, 564) pyroxene and plagioclase in the xenoliths in contact with this mesostasis tend to be corroded, and many clino-pyroxenes show fritted, riddled margins. Whisps and fibrous sheaves, in the mesostasis and bordering some pyroxenes, appear to represent incipient crystallisation of ortho-pyroxene, some clino-pyroxene and sillimanite or mullite(?). The

mesostasis includes feldspar and iron ore relics and is charged with granular iron ore, passing into opaque black glass. It contains sporadic amygdales with analcime, natrolite and other zeolites, rare groups of skeletal tablets of alkali feldspar (sanadine?), and patches of chalcedony, partly fringed with lussatite and showing curved fracture reminiscent of cristobalite (563). Clear to pale yellow or brown, partly devitrified, feldspathic glass forms around fused ends of plagioclase laths projecting into the mesostasis; this sometimes contains small elongate prisms of colourless clino-pyroxene. Scattered xenocrysts of clino-pyroxene (with incipient chloritisation) and plagioclase (with fused glassy borders partly replaced with colourless clino-pyroxene) in the basalt host are probably derived from the dolerite xenoliths.

Rare peridotite xenoliths (562) contain olivine ($2V_z$ 86-97° ≈ Fo_{94-74}) showing translation lamellae, some colourless clino-pyroxene ($2V_z$ 63-66°; Z:c 48-50°) and minor plagioclase (≈Ab_{35-55}). Rare xenocrysts (to 8 mm.) of grey, brown or olive-green spinel (analysis 5, table 2, Sutherland 1969*b*) are marginally altered to opaque iron ore. Sparse large clots of opaque iron ore in the basalt probably represent completely altered spinel xenocrysts and are sometimes overgrown with titaniferous augite. Rare, small glassy xenoliths, up to 2 mm. across, may represent Tertiary sediment fused to brownish or colourless glass, bordered and replaced by clino-pyroxene.

The rock is an under saturated alkali olivine-basalt, with a fairly high lime and magnesia and low alkali content (analysis 9, table 1, Sutherland 1969*b*); this presumably reflects the abundance of augite megacrysts. Analyses of the augites show that cores have higher alumina and soda and lower calcium, compared with reactions rims and overgrowths, suggesting crystallisation at depth (analysis 1 - 4, table 2, Sutherland 1969*b*). There is also an increase in titanium, correlating with coloration in overgrowths compared with cores and reaction borders.

Source and Age

The outcrop of the basalt, with the inclusion of numerous partially melted xenoliths of country rock, as well as augite megacrysts, suggests an eroded plug.

The basalt post-dates adjacent Palaeocene-Eocene beds. Its isolation indicates considerable subsequent erosion, but further field evidence of age is absent.

OLIVINE-BASALT

Isolated remnants of this rock occur south of White Hills and east of Rose Rivulet. The basalt descends from about 750 feet elevation on the east to 200 feet near Talisker Farm, where it shows its maximum thickness of about 100 feet. It disconformably overlies inter-volcanic conglomeratic beds and Palaeocene-Eocene sediments. A contact in the quarry above Talisker Farm dips very steeply west, with slight baking of the underlying sediments.

The basalt is massive, but in places carries sporadic amygdales commonly containing natrolite and other zeolites. Inclined cooling columns are exposed in the quarry at Talisker Farm, and at one point form "synclinal" structure. A deeply weathered outcrop at 750 feet at 1580E - 8650N appears to represent a lateritised remnant of the basalt (Woodstock B surface; Nicolls 1960).

Petrology

Thin sections (19 slides) show olivine and augite phenocrysts in a groundmass of plagioclase, augite, iron ore, minor olivine, and glassy mesostasis.

Corroded olivine (16-24%; 2 mm. max., mostly to 1 mm.) is slightly glomeroporphyritic. Titaniferous augite (28-37%) forms glomeroporphyritic phenocrysts, rosettes and interganular grains (to 1.2 mm.) and is colour zoned ($Z:c\ 44\text{-}50^{\circ}_{core}$ —— $48\text{-}54^{\circ}_{rim}$). Laths and anhedral plates of labradorite (to 1 mm.) are zoned from An_{38} and show some flow alignment. Iron ore (4-8%) is dispersed in squarish to irregular grains (mostly to 0.1 mm.), or as lath-like crystallites in the mesostasis. Apatite (2%) forms numerous needles in late-stage plagioclase and in the mesostasis.

The mesostasis (up to 20%) is an intersertal to almost hyalopilitic, glassy residue, generally clouded with crystallites. In some sections (195, 201, 202, 218, 280, 283) it is largely crystallised to interstitial zeolites (including analcime), with minor nepheline(?) and biotite, but in others (212, 280, 288, 380) it passes into brownish glass. Sporadic amygdales contain zeolites, calcite and a little greenish clay or chalcedony.

Small xenoliths of Tertiary sediment (283, 291, 296) are commonly fused to clear or brownish glass, partly replaced with prismatic, colourless clino-pyroxene. Some xenoliths develop envelopes of brownish glass interspersed with the host rock. Rare, resorbed pyroxene xenocrysts (372) to 4 mm. across, are largely replaced with exsolved plates of colourless augite ($2V_z 56^{\circ}_{core}$ —— 53°_{rim}) and partly overgrown with titaniferous augite ($2V_z 51^{\circ}_{inside}$ —— $56^{\circ}_{outside}$).

The basalt resembles the host Corra Linn basalt, but lacks the numerous augite megacrysts, and also resembles the lower olivine-basalt at Strathlyn in the upper Tamar. It is an under saturated alkali olivine-basalt, approaching a basanite in composition (analysis 10 and 11, table 1, Sutherland 1969*b*). The dark, glassy mesostasis-rich variety (analysis 11) is slightly enriched in iron oxide and soda at the expense of alumina, lime and potash, compared with the more typical rock (analysis 10).

Source and Age

The basalt flowed into a small steep valley near Talisker Farm, but its precise source is uncertain. It may represent an isolated branch of the coarse basalt flow erupted from Cocked Hat Hill, but it is possibly an earlier eruption, as discussed under inter-volcanic sediments, and its highest point at Currachmore Farm slightly exceeds the elevation of Cocked Hat Hill. This suggests a separate eruption, which flowed west from the vicinity of Currachmore Farm. A further alternative is eruption from the plug at Corra Linn, with lava flowing south towards Currachmore Farm and then west down to Talisker Farm.

The basalt post-dates dissection of the Palaeocene-Eocene sediments and overlying inter-volcanic conglomerates. The apparent deep weathering and lateritisation of the basalt at 1580E - 8650N suggests an early Pliocene upper age limit, based on arguments of Nicolls (1960) and dating of similar profiles in Victoria (Gill 1964). Within these limits, the dissection of the underlying beds, based on stratigraphic relationships in the area and on the known history of Bass Strait (as discussed for the middle Tamar area), was most likely in the Upper Oligocene or Upper Miocene-Lower Pliocene. This gives late Oligocene-early Pliocene age limits for the basalt.

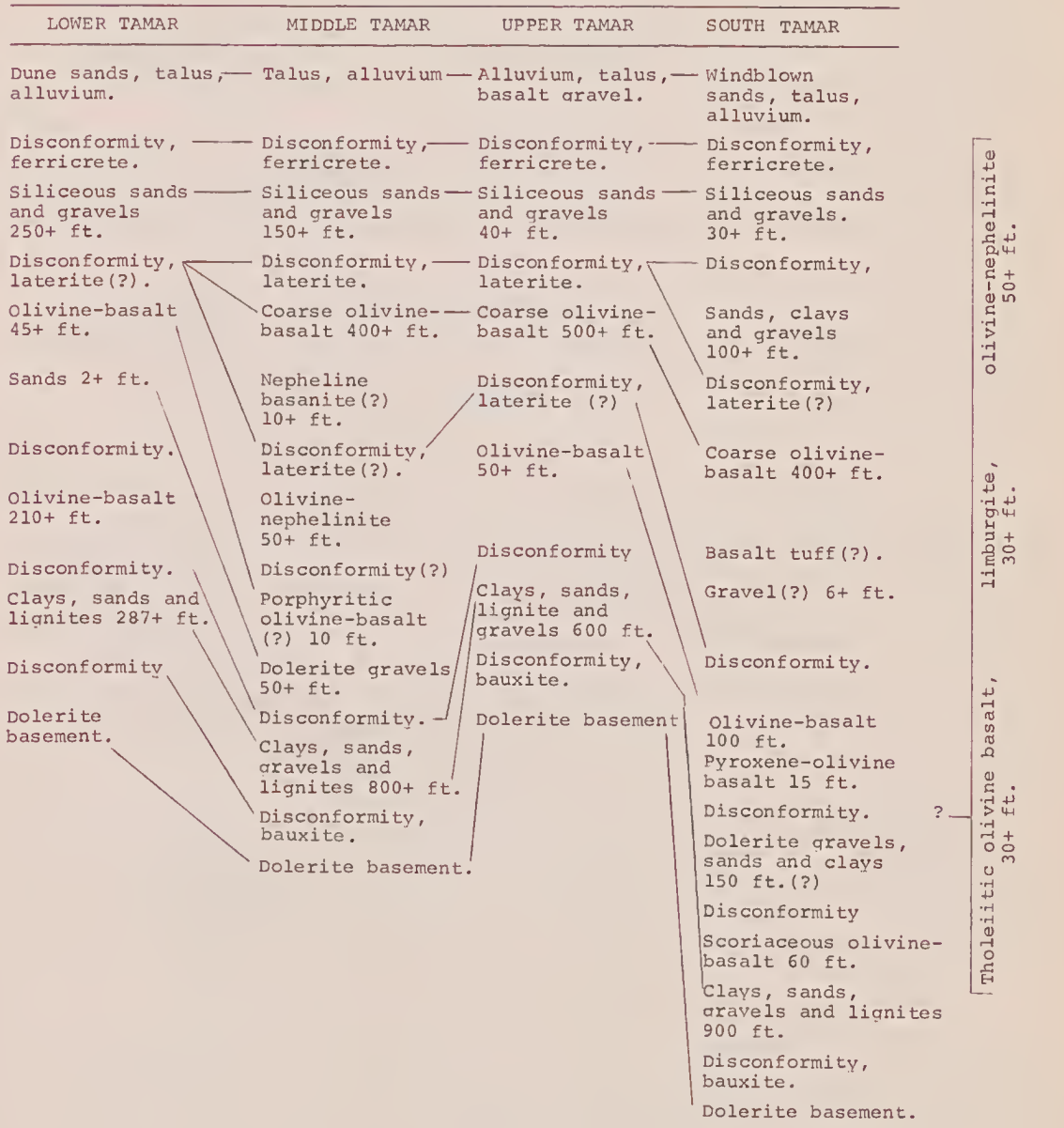

TABLE 1.

Stratigraphic Successions, Tamar Trough, showing probable correlations.

COARSE OLIVINE-BASALT

Coarse basalt outcrops west of Rose Rivulet from Breadalbane to Evandale and in isolated exposures in the Perth-Longford area. It disconformably overlies inter-volcanic conglomeratic beds and underlying Palaeocene-Eocene sediments. It is partly buried by probable Tertiary beds and younger siliceous sands and gravels.

The basalt base overlaps Jurassic dolerite on its western margin at elevations between 500-630 feet and descends to 300-350 feet on its eastern margin. The highest point on the basalt forms Cocked Hat Hill at 725 feet, indicating a maximum flow thickness of at least 200 feet, and possibly up to 425 feet.

The basalt is massive, develops cooling columns in places, and in parts is strongly decomposed and granular in appearance. There are sporadic amygdales and in a small cut below Mt. Oriel Farm these contain natrolite. Scoriaceous basalt tuffs are recorded below the basalt in railway excavations at Breadalbane and a coniferous forest flora overwhelmed in the tuff is listed (Johnston 1874, 1875, 1888), but these exposures are now covered.

Petrology

In thin sections (17 slides) the rocks are mostly medium grained and similar to coarse basalts described from the middle and upper Tamar areas, but no marked picritic and pegmatitic varieties were noted. The titan-augite in the rocks is predominantly intergranular, with little development of subophitic to ophitic texture, and the mesostasis is mostly types 2 or 3. The coarsest rock (213) forms the summit of Cocked Hat Hill, and is a feldspathic, olivine-poor variety compared with some of the rocks from lower levels, suggesting an upper differentiated zone. Near the base the basalt grades into fine grained rock (165, 216, 300, 578, 579) petrologically similar to the olivine-basalt east of Rose Rivulet, but in places a medium grain size is maintained to the basal contact (379).

Petterd (1902) gives a microscopic description of a hydrated olivine-basalt, resembling 'palagonite' in appearance, found in sinking holes at Native Point, Perth, but no exposures of this rock were found by the present author. Its precise relationship to the coarse basalt outcropping along the river bank below Native Point Farm is uncertain, but it may be a weathered form.

Source and Age

Johnston (1888) considered that the eminence of Cocked Hat Hill formed the principle eruptive vent for the Breadalbane flow, and he recorded tuffs nearby. A recent regional gravity survey indicated the eixstence of a large dyke extending to depth below Cocked Hat Hill (M. J. Longman and D. E. Leaman pers. comm.)

The eruption of thick lava here may have blocked the old Tamar at Evandale (fig. 12), diverting it through Longford via the gorge to Launceston and forming the South Esk (Carey 1946). However, much of the lava extends upstream from the probable eruptive point of Cocked Hat Hill. Unless there has been extensive removal of basalt downstream, this may mean that the Tamar was already diverted through Longford by another of the lavas in the area, prior to effusion of the coarse basalt.

The coarse basalt post-dates dissection of Palaeocene-Eocene sedi-

TABLE 2. Proposed Cainozoic History of the Tamar Trough

UPPER OLIGOCENE - PALAEOCENE	--?--	(1) Epeirogenic uplift with vertical faulting and tilting forming the Tamar Trough.
		(2) Dissection (with bauxitisation?) of Jurassic dolerite basement and formation of main Tamar drainage system.
		(3) Deposition of non-marine clays, sands, gravels and lignites, with intervals of erosion and lateritisation (and possible minor volcanic activity). Tamar channel cut to 65+ feet below present sea level in the lower Tamar.
	--?--	(4) Eruption of olivine-basalt into the lower Tamar (and possible lava eruptions in the south Tamar). Possible diversion of the Tamar, west through Beaconsfield between West and Badger Heads.
MIOCENE - UPPER OLIGOCENE (?)		(5) Dissection, with deposition of dolerite gravels, sands and clays in the lower, middle and south Tamar.
		(6) Eruption of olivine-basalt at East Arm, flowing into the lower Tamar. Possible dissection.
		(7) Eruptions of olivine-nephelinite, basanite and alkali olivine-basalt in the middle, upper and south Tamar, with intervening dissection and lateritisation (?).
		(8) Eruptions of thick flows of coarse alkali olivine-basalts in the middle, upper and south Tamar areas, filling the Tamar channel to well below present sea level in the middle and upper Tamar. Diversion of the Tamar through Longford as the South Esk (or already diverted) and possible rediversion of the Tamar eastwards at Long Reach through the Tamar Heads. Eruptions possibly continue into the Pliocene.
		(9) Possible deposition of sands and gravels on some basalts at higher levels related to Miocene marine transgression in Bass Strait.
	--?--	(10) Dissection, with entrenchment of Tamar following marine regression in Bass Strait.
PLIOCENE		(11) Lateritisation of valley profiles forming the Woodstock surface.
		(12) Dissection and deposition of fluviatile beds containing basalt and laterite fragments at Perth.
QUATERNARY	--?--	(13) Dissection by Tamar drainage in lower reaches to below sea level during Glacial low seas. Drowning of Tamar mouth during Interglacials, with deposition of siliceous sediment and formation of terrace levels associated with the high marine stands. Development of levels at 200-250 feet (possibly a Tertiary level), 90-100 feet, 60-70 feet, 40-50 feet, 30 feet and 10-15 feet above M H W S around Tamar mouth. Development of ferricrete and other soils. Extensive land slippages forming large talus deposits below basalt cappings.
		(14) Deposition of windblown littoral and inland sand. Deposition of estuarine sediments associated with establishment of the Post-Glacial sea. Development of coastal beach ridges at Tamar heads. Recent slight recession of estuary level (?) giving present deposition of estuarine and fluviatile alluvium. Deposition of current erosive and land slip debris.

This Table incorporates some further palynological dates on the Tamar Trough sediments from samples submitted to the South Australian Department of Mines since the main part of the script was written. Carbonaceous clays from just beneath the basalt flow exposed in the Launceston Port Authority excavation project at Garden Island (at -35 feet below A.L.T.) and from under the basalt in the Tasmanian Mines Department Tamar Avenue Bore, Georgetown (at +15 to -8 feet S.L.), yield Mid-Tertiary assemblages containing *Cyatheacidites annulata*, and the look of the Georgetown assemblage appears to be older than Longfordian in age. (W. K. Harris, pers. comm.). This suggests an Upper Oligocene age for these non-marine beds, which is consistent with their relatively low position compared with known deposits of the Lower Miocene marine transgression on northern Tasmania. These are the youngest sub-basaltic beds yet identified in the Tamar Trough and they probably represent deposits associated with and dating the Tamar channel prior to its occupancy by the lower olivine-basalt.

ments and inter-volcanic gravels, and possibly post-dates the olivine-basalt east of Rose Rivulet (late Oligocene-early Pliocene). Its decomposed surface is overlain by probable Tertiary sediments at Perth, indicating Mid to Upper Tertiary age limits and an approximately comparable age to the coarse basalts in the middle and upper Tamar areas.

DISCUSSION

The Tamar volcanism and its relationships to the Cainozoic history of the Tamar Trough, as deduced in this study, is summarized in table 2. One feature is the apparent absence of Miocene marine or littoral sediments within the Trough, an expected inlet for the major Miocene marine transgression recorded elsewhere in northern Tasmania and south-eastern Australia (Ludbrook 1967). Such deposits may have been removed by subsequent erosion, but a possible explanation is that in the Miocene the northern end of the Tamar Trough was blocked with sufficient thickness of basalt to prevent access by the sea.

The volcanism of the Tamar Trough is essentially representative of the alkaline volcanic associations in Tasmania (Sutherland 1969*a*, 1969*b*), but minor tholeiitic extrusion occurs in the south-eastern end. Preliminary investigations of the Tertiary volcanic rocks in adjacent areas (Sutherland 1968, 1969*c*) show that the Tamar Trough falls within an alkaline volcanic association extending east to the Devonport-Sheffield area, but passes into a zone of tholeiitic basalts to the east and south from Pipers Head to Campbell Town.

The general alkaline volcanic sequence, suggested by the stratigraphy of the Tamar Trough, shows initial extrusions of near saturated alkali olivine-basalt, followed by more alkaline under saturated lavas of olivine-nephelinite, then under saturated alkali olivine-basalts and basanite(?), and finally massive effusions of under saturated to near saturated coarse alkali olivine-basalt. Whether such successions are typically developed in the alkaline volcanic associations in Tasmania has yet to be resolved, pending more detailed work in other areas. However, the proposed Tamar succession closely compares with a sequence established in the Older Volcanic Series alkaline association of Victoria at Bacchus Marsh (Jacobson and Scott 1937). Flows tend to be thinner and more numerous, and olivine-nephelinites are more prominent, in the Bacchus Marsh sequence, but a similar genesis and magmatic history is suggested for the two sequences, with some differences in the eruptive pattern.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the assistance of numerous persons during this study, in particular Dr. A. H. Spry, A.M.D.L., Adelaide, South Australia; Professor S. W. Carey, Dr. R. Varne, Mr. M. R. Banks, Mr. D. McP. Duncan, Mr. C. Gee, Mr. R. J. Ford, Geology Department, University of Tasmania; Mr. E. D. Gill, National Museum of Victoria; Mr. K. D. Nicolls and Mr. G. Dimmock, C.S.I.R.O. Division of Soils; Mr. M. J. Longman, Dr. R. D. Gee, Mr. W. L. Matthews, Mr. I. B. Jennings, Dr. D. I. Groves and Dr. E. Williams, Mines Department of Tasmania; Dr. K. L. Burns, Geology Department, Macquarie University; Dr. D. H. Green, Dr. I. McDougall and Mr. N. Gray, Department of Geophysics and Geochemistry, Australian National University; Mr. W. K. Harris, Mines Department of South Australia; and Mr. R. C. Kershaw and Mr. J. Allchin of Launceston.

Considerable help with geological reports and bore cores was extended by Mr. J. K. Edwards, Port Manager, Port of Launceston Authority, and Mr. A. L. Ellis, General Manager, Comalco Aluminium (Bell Bay) Ltd. The

author also wishes to thank Mr. T. D. Hughes, former Chief Geologist, and Mr. G. Everard, of the Mines Department of Tasmania, for assistance with thin sections; and the officers of the Tasmanian Departments of Public Works and Lands and Surveys, for their co-operation.

Most of the field work was done while the author was employed at the Queen Victoria Museum, Launceston, and much help and guidance was given by Mr. W. F. Ellis, Director of the Museum, and the staff at the Launceston City Council. The work was completed at the author's present place of employment and he wishes to thank Dr. W. Bryden, Director, Mr. M. Bower, and others of the Tasmanian Museum staff for their help.

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FOOT AND PLAYSTED LAUNCESTON

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TWO NEW SUBSPECIES OF

BRACHYGALAXIAS EIGENMANN, 1928

by

E. O. G. SCOTT

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ON THE OCCURRENCE IN TASMANIA AND ON FLINDERS ISLAND OF BRACHYGALAXIAS EIGENMANN, 1928 (PISCES: GALAXIIDAE) WITH DESCRIPTIONS OF TWO NEW SUBSPECIES

by

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Manuscript received 15/1/1971 *Published 21/5/1971*

ABSTRACT

The occurrence in Tasmania and on Flinders Island, Furneaux Group, Bass Strait, of the galaxiid genus *Brachygalaxias* Eigenmann, 1928 is reported, and descriptions are given of two new subspecies of the Victorian *B. pusillus* (Mack), 1936, namely, *B. p. tasmaniensis subsp. nov.* from north-eastern Tasmania and *B. p. flindersiensis subsp. nov.* from Flinders Island. The Western Australian member of the genus originally described as a subspecies of the Victorian fish, *B. p. nigrostriatus* (Shipway), 1953, is treated as a distinct species.

INTRODUCTION

In the course of a survey of the genus *Brachygalaxias* Eigenmann, 1928 several new forms have been met with. As early publication of the complete study appears improbable, it has been considered expedient at this stage to report the discovery of the genus in Tasmania and on Flinders Island, Furneaux Group, Bass Strait, and to make available descriptions of material from these sources, regarded as constituting two subspecies of *B. pusillus* (Mack), 1936 from Victoria. An incidental mention of the Tasmanian fish has been made earlier (Scott, 1966: 247).

The status of *Brachygalaxias vis-à-vis Galaxias* Cuvier, (1816) has been discussed by the writer elsewhere (1966). Recent studies of the caudal skeleton by Greenwood, Rosen, Weitzman & Myers (1966) and by McDowall (1969) would appear to add one or more to about a dozen differences between the two genera noted in the paper cited. Though *Brachygalaxias* was not recognized by either of the two Australian authors — Mack (1936), Shipway (1953) — of species now regularly referred to it, and while the question of its validity was expressly left open by another local writer — Mees (1961) — Eigenmann's genus is now almost universally accepted.

CONVENTIONS

Measurements are made between parallels; being estimated to the nearest tenth of a millimetre. Absolute dimensions, however, are not recorded in the tables, nor in general cited in discussion (except in the cases of standard length, total length); all direct measurements (*i.e.*, magnitudes other than ratios) being expressed as thousandths of standard length (*TLs*). Standard deviation and derived quantities (*e.g.*, coefficient of variation) are regularly calculated, irrespective of size of sample, with n, not $(n-1)$, degrees of freedom. Procedures follow the recommendations for small samples by Simpson & Roe (1939). In frequency distributions in the text, figures in parentheses denote number of items in the relevant class. It may here be noted, for convenience of immediate reference, that in the estimation of the significance of differences of mean values the least value of t, for the smallest pooled sample considered, at $P_{0.05}$ is 2.086, at $P_{0.01}$ 2.845.

Discussion of the provenance of the material examined raises a minor semantic problem (not confined to the present context). To refer to Australia, Tasmania, and Flinders Island as if they represented separate entities of equivalent status is of course to commit a solecism in political geography, Tasmania being one of the States of Australia, and Flinders Island being part of the State of Tasmania. However, to allow due zoogeographical weight to the fact that three discrete land-masses are here involved, and to obviate recourse to the somewhat cumbersome 'mainland of Australia' and the unfamiliar 'mainland of Tasmania', a common local usage is conveniently followed, the three names being treated as being those of three independent and self-contained regions.

THE STATUS OF *Galaxias pusillus nigrostriatus* SHIPWAY, 1953

Galaxias pusillus nigrostriatus Shipway. 1953. *W. Aust. Nat.*, 3(8): 173, unnumbered fig. on p. 174. Type locality: small drain feeding into Marbellup Creek, near Albany, Western Australia.

Brachygalaxias pusillus nigrostriatus (Shipway). Munro, 1957, *Handbk Aust. Fish.*, 7 : 32, fig. 225 in *Aust. Fisher. Newsl.* (now *Aust. Fisheries*), 16(1).

Brachygalaxias nigrostriatus (Shipway). Whitley, 1964, *Proc. Linn. Soc. N.S.W.* , 89(1): 35.

As the present paper proposes new subspecies of *Brachygalaxias pusillus* (Mack), 1936 from Victoria some consideration needs here to be given to the Western Australian galaxiid, *Galaxias pusillus nigrostriatus* Shipway, 1953, treated by its describer as a subspecies of the eastern form. However, in agreement with Whitley (1960, 1964), the writer considers Shipway's fish, now generally relegated to *Brachygalaxias*, to be specifically distinct from Mack's. Unfortunately, the original figure — reproduced in Munro's Handbook and in Whitley (1960) — is not wholly accurate; and the following observations are based on an examination of the holotype, courteously made available for inspection by the Western Australian Museum, Perth.

Brachygalaxias nigrostriatus is recognizable at sight by its much larger anal; with 12 rays, against a mode of about 8 and a maximum of 10 in *B. p. pusillus* and in the Tasmanian and Flinders Island subspecies here described. The fin has a base extending through 200 *TLs* units (*cf.* three subspecies means of 104, 110, 124, with an outlying individual entry of 150 : see table 4); slightly exceeding (*cf.* about 1.5-2 in) length of caudal peduncle; subequal to length of head (*cf.* subequal to length from tip of snout to back of eye); subequal to (*cf.* about 1.5 in) ventral-anal interval. The

disproportion in length between dorsal and anal bases is striking, the former being contained twice in the latter in *B. nigrostriatus*, but, on the average only 1.4, 1.5, 1.3 times in the Victorian, Tasmanian, Flinders Island fish, respectively. *B. nigrostriatus* possesses a much longer pectoral, the length of the central rays being equal to the distance from snout tip to preoperculum (*cf.* to ocular border); a noticeably longer caudal, exceeding (*cf.* about 0.6 - 0.8) length of head.

Summarizing the original accounts of *B. pusillus* and *B. nigrostriatus*, Munro (1957) contrasts ventral origin 'slightly nearer to snout than tail base' in the former with ' midway between snout and tail base' in the latter : in our examples of the Victorian fish ventral origin ranges from slightly in front of to slightly behind the middle of the standard length, while in the holotype of the Western Australian fish it is located a little nearer to snout tip than to hypural joint. Again, ventral is stated to extend 1/3 of distance to anal in the former species, 0.6 in the latter species; however, as the data in table 4 show, the Victorian value ranges from 0.3 to 0.6. Little if any diagnostic significance would seem to be attachable to variations noted in the shape of the 'symphysial cranial pore'.

As figured, *B. pusillus* has 3 longitudinal black lines on the side, *B. nigrostriatus* 2 only. In our material of the former (all subspecies) 3 lines are almost always present: in the holotype of *B. nigrostriatus* there is no trace of a third, dorsally situated stripe; further, the remaining stripes are set closer together than is usual in the other form (apparently being more approximated than in the figure; and with the upper stripe originating somewhat lower down, as in Mack's illustration of his form, about at the level of the middle, instead of the upper border, of the orbit as illustrated).

The Western Australian fish is here recognized as a full species, and is not made the subject of further consideration in this investigation.

Brachygalaxias pusillus tasmaniensis subsp. nov.

'An undescribed Tasmanian form' Scott, 1966, *Aust. Zool.*, xiii, (3):247.

Diagnosis. - General characters those of the species.

Exhibits statistically significant differences from the Australian *B. pusillus* (Mack), 1936 in respect of the following direct dimensions, expressed as millesimals of standard length: length of pectoral, length of ventral, snout, eye, interorbital, maximum depth, depth of hypural joint (without caudal ridges) - the larger value being found in the new form in all cases except size of eye. Statistics of these dimensions are set out in table 1 *(B. p. pusillus)* and table 2 *(B. p. tasmaniensis)*.

Derived magnitudes with means yielding statistically significant differences include: snout in eye, eye in interorbital, pectoral-ventral interval in length of pectoral, ventral-anal interval in length of ventral, interval between anal and dorsal origins — the (numerically) larger value being found in the Tasmanian form in all cases except snout in eye. Specifications of these magnitudes are given in table 4.

Table 5 records *t*- values for differences of means of lengths and ratios listed in the last two paragraphs.

In the material examined, the pectoral of *B. p. pusillus* is consistently shorter than the caudal, the mean difference (47.9 *TLs*) being more than one-third of pectoral length (*t* 8.386); in *B. p. tasmaniensis* the pectoral is modally longer than the caudal, the difference of the means just being significant at *t* 2.095.

Ventral rays 4, rarely 5 (*cf.* 5, rarely 4).

Differs statistically from *B. p. flindersiensis subsp. nov.* in a number of features, enumerated in the diagnosis of that form below.

Meristic characters. - D. 6(1), 7(11), 8(2); longest ray (counting here only rays clearly visible) 4th (9), 4th - 5th (3), 5th (2). A. 8(5), 9(6), 10(3); longest (clearly visible) ray 4th (10), 4th-5th (2), 5th (2). P.11 (4), 12 (10). V.4(13), 5(1). C.13(10), 14(4). It is not always feasible to make a definitive count of the myomeres: however, the following counts are probably reliable to within one or two myomeres: 18(4), 19(4), 20(6) + 18(7), 19(7); total 36(2), 37(3), 38(7), 39(2). In 5 (additional) cleared specimens the vertebrae number 18 + 20(2), 18 +21(1), 19 + 20(1), 19 + 21(1), mean total 38.4.

Some other characters. - Lower jaw slightly longer than upper (13), slightly shorter (1). Mouth extending to midway between anterior nostril and eye (1), to just short of eye (3), to eye (8), to 0.05 eye (1), to 0.1 eye (1). Pectoral extending 0.55 - 0.70 ($\bar{x}$ 0.63 ± 0.01) of distance towards ventral; ventral extending 0.43 - 0.67 ($\bar{x}$ 0.57 ± 0.02) of distance towards anal. Dorsal originating above 3rd (1), 3rd - 4th (1), 4th (4), 4th - 5th (7), 5th (1) anal ray (clearly visible ray). Anal terminating slightly before or slightly behind (on average, a little in advance of), dorsal termination. Caudal rounded.

Coloration. - The original description of *B. pusillus* notes 'colour in spirit pale yellowish with three longitudinal black lines on sides of body' (a longitudinal color pattern appears to be characteristic of the genus). No reference is there made – nor does any occur in the Handbook (Munro, 1954) – to the presence in life of the striking red or orange stripe along the flank reported for *B. bullocki* (Regan), 1908 and *B. nigrostriatus* (Shipway), 1953. Opportunity is here taken to report the life colors of the Tasmanian fish.

Three dark, black or almost black longitudinal lines along whole length of body; uppermost stripe usually the narrowest and least intense, sometimes discontinuous, occasionally obsolescent, originating near upper angle of operculum, and running back close to the dorsal profile, arching upward a little under dorsal base, caudad of which it defines the profile (apart from caudal ridge); middle stripe originating shortly below upper, continuing back subparallel with it, to end at midpoint of caudal base; lowest stripe most conspicuous, continuous, up to twice as wide as either of the others, beginning on head, about at level of bottom of orbit, proceeding, almost straight or very gently convex upward, obliquely backward and downward to region of vent, thereafter straightening out, and extending, either along or barely dorsad of, the ventral border to caudal base: each of the stripes may exhibit, through part or all of its length, a slight local expansion, variable in form and extent, on each myomere. The narrow strip of lateral surface above the superior black stripe, and the contiguous dorsal surface variously yellowish, greyish green, pale olivaceous, frequently with scattered dark chromatophores, at times very numerous; between the upper two stripes yellow or greenish,

usually immaculate. Above the lowest stripe a conspicuous band of bright red, commonly blood red, or orange, either almost even in width throughout or widening posteriorly, sharply delimited above and below, its upper border just meeting the middle black stripe at its hind end, but gradually departing from it cephalad, to lie, at the pectoral, below it by a distance subequal to its own width; the interspace here yellowish, at times slightly dusky (in preserved specimens the red band is often represented either by a continuous or subcontinuous broad white line, or, more commonly, by a regular series of closely set white subrectangular bars, sloping downwards and backwards, one bar to a myomere). Flank below inferior dark stripe silver or silvery white. Ventral surface whitish; normally with two longitudinal series of black spots and/or dashes, extending backward from isthmus more or less parallel to one another, to, or near to, anal base, where they may cease, or beyond which they may continue merely along the fin base, or along it and behind it, or may recommence behind the fin, either retaining their identity in their course along the caudal peduncle, or becoming more or less wholly confluent with the lowest dark stripe of the flank. Ventral surface of head whitish; dorsal surface more or less concolorous with dorsal surface of trunk, often with darker patch or patches on, or on and in advance of occiput; lateral surface yellowish or pale yellowish green; sometimes one or two blood-red spots between orbit and opercular border; pupil black; iris with red, green, gold annulus, more or less surrounded by silver, which may be streaked or mottled with black; lips dusky or dark. Fins other than caudal mostly pale or colorless, the rays normally margined, very narrowly, with blackish; caudal rays orange through all or much of their length, black-bordered throughout. Caudal ridges hyaline or pale yellowish, often partly, occasionally wholly, margined with a very fine dark line.

Material. - Described from 14 specimens: 2 from a soak from a dam flowing towards the coast (northward) on *Marengo*, Waterhouse Estate, Dorset, Tasmania, collected by Mr A. M. D. Hewer, March 1964, kept alive by Mr B. C. Mollison till 26 September 1964; 12 from a series from the same locality — associated with pygmy perch, *Nannoperca australis tasmaniae* (Johnston) 1883, and a species of *Saxilaga, cf. S. cleaveri* (Scott), 1934 — collected by Mr A. M. D. Hewer, Mr B. C. Mollison and Mr D. Smith, 17 October, 1964. (Frankenberg (1967) has noted the common association, in low-lying swampy country, in Victoria of *Brachygalaxias* with the local pygmy perch, *Nannoperca australis australis* Günther, 1861.) Standard length (mm) 23.1 - 31.1; $\bar{x}$ 25.33 ± 0.63; σ 2.36 ± 0.45; V 9.3 ± 1.8: total length 27.1 - 35.7; $\bar{x}$ 29.37 ± 0.67; σ 2.50 ± 0.46; V 8.5 ± 1.6. The largest individual, standard length 31.1 mm, total length 35.7, is selected as holotype (Queen Victoria Museum Reg. No. 1970/5/25*a*), the rest of the described specimens being designated paratypes. Six additional cleaned and stained specimens have also been examined. Paratypes will be offered to the British Museum (Natural History), London, and the Australian Museum, Sydney.

The *Brachygalaxias pusillus pusillus* material used for comparative purposes comprises 13 specimens (several imperfect), including 4 paratypes, made available for examination by courtesy of the National Museum of Victoria. Several examples collected by Mr R. S. Frankenberg at Tyob, Victoria have also been examined; 2 of these have being cleared and stained.

Distribution. - At present known only from north-eastern Tasmania.

Brachygalaxias pusillus flindersiensis subsp. nov.

Diagnosis. -General characters those of the species.

Exhibits statistically significant differences from the Australian *B. pusillus pusillus* (Mack), 1936 in respect of the following direct dimensions, expressed as millesimals of standard length: length of pectoral, length of ventral, head, snout, eye, interorbital, maximum depth, depth at hypural joint (without caudal ridges) — the larger value being found in all cases in the new form. Statistics of these dimensions are set out in table 1 *(B. p. pusillus)* and table 3 *(B. p. flindersiensis).*

Derived magnitudes with means yielding statistically significant differences include: snout in eye, snout in head, pectoral-ventral interval in length of pectoral, ventral-anal interval in length of ventral — the (numerically) larger valve being provided for the first two items by the new subspecies, for the other two items by the typical subspecies. Specifications of these magnitudes are given in table 4.

Table 5 records *t*-values for differences of means of lengths and ratios listed in the last two paragraphs.

In the material examined, the pectoral of *B. p. pusillus* is consistently shorter than the caudal, the mean difference (47.9 *TLS)* being more than one-third of pectoral length (*t* 8.368); in *B. p. flindersiensis* the fins are subequal (pectoral mean 170.4 ± 3.69, caudal mean 167.3 ± 4.44, the difference of the means not being formally significant).

Ventral rays 4 (*cf.* 5, rarely 4).

Exhibits statistically significant differences from the Tasmanian *B. p. tasmaniensis subsp. nov.* in respect of the following direct dimensions, expressed as millesimals of standard length: head, snout, eye, maximum depth, depth at vent, minimum depth of caudal peduncle (including caudal ridges), length to anal termination — the larger value of the first three items being encountered in *B. p. flindersiensis,* of the remainder in *B. p. tasmaniensis.* Statistics of these dimensions are set out in table 2 *(B. p. tasmaniensis)* and table 3 *(B. p. flindersiensis).*

Derived magnitudes with statistically different means include: snout in head, eye in interorbital, interval between anal and dorsal origins, anal base — the (numerically) larger value for all entries being that of *B. p. tasmaniensis.* Specifications of these magnitudes are given in table 4.

Table 5 records *t*-values for differences of means of lengths and ratios in the last two paragraphs.

In the material examined, the pectoral and caudal fins of *B.p.flindersiensis* are subequal in length (see above); in *B. p. tasmaniensis* the pectoral is modally longer than the caudal (*t* 2.095).

Ventral rays 4 (*cf.* 4, rarely 5, in *B. p. tasmaniensis).*

Meristic characters. - D.7(8), 8(7); longest ray (counting here only rays clearly visible) 3rd - 4th (1), 4th (14). A.7(1), 8(7), 9(6), 10(1); longest (clearly visible) ray 3rd (1), 4th (9), 4th - 5th (3), 5th (2). P.11 (3). 12 (10), 10/11 (1), 12/13 (1). C.13 (14), 14 (1). Approximate number of myomeres: 19 (2), 20 (2), 21 (11) + 17 (2), 18 (8), 19 (4), 21 (1); total 36 (1), 37 (1), 38 (3), 39 (4), 40 (5), 42 (1). In 8 (additional) cleared specimens the vertebrae number 17 + 20 (1), 17 + 21 (1), 18 + 19 (1), 18 + 20 (2), 19 + 20 (2); 21 + 17 (1); mean total 38.0.

Some other characters. - Lower jaw slightly longer than upper (13), jaws equal (1), upper jaw slightly the longer (1). Mouth extending to within 0.15 eye-diameter of eye (1), within 0.1 (6), just short of eye (2), to eye (5), to 0.1 eye (1). Pectoral extending 0.49 - 0.77 ($\bar{x}$ 0.61 ± 0.3) of distance towards ventral; ventral extending 0.47 - 0.69 ($\bar{x}$ 0.55 ± 0.01) of distance towards anal. Dorsal originating above 2nd - 3rd (1), 3rd (9), 3rd - 4th (3), 4th (2) anal ray (clearly visible ray). Anal terminating usually (13) in advance of dorsal termination (*t* 2.417). Caudal rounded.

Material. - Described from 15 specimens from Lackrana, Flinders Island, Furneaux Group, Bass Strait, collected by Messrs R. and C. Rhodes, one example on 4 June, 1969, the remainder part of a series from the same locality, collected 3 July, 1969 (Queen Victoria Museum Reg. No. 1969/5/25). Standard length (mm) 20.8 - 31.3, $\bar{x}$ 23.36 ± 0.71, σ 2.76 ± 0.50, V 11.8 ± 2.2: total length 24.1 - 36.6, $\bar{x}$ 27.45 ± 0.76, σ 2.96 ± 0.54, V 10.7± 2.0. The largest individual, standard length 31.3, total length 36.6 is selected as holotype (Queen Victoria Museum Reg. No. 1969/ 5/25 *a*)the rest of the described specimens being designated paratypes. Eight additional cleared and stained specimens have also been examined. Paratypes will be offered to the British Museum (Natural History), London, and the Australian Museum, Sydney.

DISCUSSION

Though the samples here subjected to statistical analysis are small, and some high and some low values of *t* are encountered (see Hubbs & Hubbs, 1953), trials of the number of entries falling within the limits $\bar{x} \pm \sigma$ yield in general figures in very satisfactory agreement with those characterizing the normal distribution - on the assumption of which distribution of the variates the standard parametric procedures are of course formally based. In most biological contexts the pragmatic weight attachable to a run of results individually statistically significant (or even rating just below formal significance) is much greater than that provided by any single such test considered separately; and in the present instance the constellation of good values of *t* exhibited in table 5 would seem to point pretty clearly to the existence of genuine taxonomic differences among the three samples from Victoria, Tasmania and Flinders Island here studied. However, these differences are, for the most part, essentially of a statistical nature, affording grounds for the separation of populations, not, unequivocally, of individuals; they are accordingly interpreted as of subspecific, but not specific, import. Perhaps the nearest approach to a definitive criterion for the separation of individuals of, on the one hand, the Victorian from, on the other hand, the Tasmanian and Flinders Island forms is that of number of ventral rays - this is specified in the description of *B. p. pusillus* as 5, and appears seldom to depart from that number, whereas a count of 4 was obtained in 13 of the 14 Tasmanian fish (1 case of 5) and in all the 15 Flinders Island examples examined. Again, relative pectoral and ventral lengths of the two new subspecies noticeably exceed those of the typical subspecies, while scarcely differing between themselves; though ventral values overlap, the minimum pectoral value of the Tasmanian form is identical and that of the Flinders Island form virtually identical (1 *TLS* unit in excess of), with the maximum value in the Australian (see tables 1, 2, 3). However, in the absence of other notable points of distinction, valid at the level of single specimens, it would appear the appropriate course is the establishment of three subspecies for the samples from the three sources.

While any objective assessment of relative affinity is obviously not feasible, the general impression gained from the handling of the material is that *B. p. tasmaniensis* and *B. p. flindersiensis* are, on the whole, more closely related to one another than either is to *B. p. pusillus*.

The discovery in Tasmania of the genus *Brachygalaxias* affords further evidence of the richness and variety of the galaxiid fauna of this State. To the 6 genera (of twice as many proposed in Galaxiidae) recognized earlier by the writer – namely, (i)*Galaxias* Cuvier, (1816), *(ii) Neochanna* Günther, 1867, *(iii) Brachygalaxias* Eigenmann, 1928, *(iv) Paragalaxias* Scott, 1935, *(v) Saxilaga* Scott, 1936, *(vi) Agalaxis* Scott, 1936, – there is now to be added *(vii) Nesogalaxias* Whitley, 1935, established for *Galaxias neocaledonicus* Weber & De Beaufort, 1913, which previously imperfectly known form has recently been studied by McDowall (1969), who finds it exhibits skeletal features that would seem clearly to be of generic importance. If this list be accepted, we find the known representation of the family, in terms of genera, in the principal centres of occurrence now stands as follows: South America 2 genera, ? 3 (*(i), (iii), ?(v)*), South Africa 1 (*(vi)*), New Caledonia 1 (*(vii)*), New Zealand 3 (*(i), (ii), (v)*), Australia 2 (*(i), (iii)*), Tasmania 4 (*(i), (iii), (iv), (v)*). However, in a recent paper McDowall (1970) has proposed, largely on osteological grounds, the inclusion of the New Zealand *Galaxias burrowsius* Phillips, 1926, referred by the present writer to *Saxilaga* , in *Neochanna*, hitherto restricted to galaxiids lacking ventral fins. If this suggestion be accepted, and if at the same time the other species that have hitherto been accommodated in *Saxilaga* – the Tasmanian *S. cleaveri* (Scott), 1934, *S. anguilliformis* Scott, 1935, and (?) the South American *S. globiceps* (Eigenmann), 1928 (which forms do not appear to have been made the subject of osteological examination) – are placed in *Neochanna*, the distribution would be: South America 2, ?3 (*(i), (iii), ?(v)* , South Africa 1 (*(vi)*), New Caledonia 1 (*(vii)*), New Zealand 2 (*(i), (ii)*), Australia 2 (*(i), (iii)*), Tasmania 4 (*(i), (ii), (iii), (iv)*). Both summaries leave undistributed *Galaxias dissimilis* Regan, 1906 if the uncertain source of the unique holotype is extra-Tasmanian; in which case the genus is to be credited to the mainland of Australia. The queried entry for South America takes note of *Galaxias globiceps* Eigenmann, 1928, the referring of which to *Saxilaga* has been mooted by Stokell (1959:268).

The record of *Brachygalaxias pusillus flindersiensis* from Flinders Island, Furneaux Group, constitutes a fourth entry on the list of galaxiid fishes from the Bass Strait Islands provided by Frankenberg (1967), who reports the presence of *Galaxias attenuatus* (Jenyns), 1892,; *G. truttaceus truttaceus* (Cuvier), (1816), and *G. coxii* Macleay, 1880.

TABLE 1

Brachygalaxias pusillus pusillus (Mack), 1936. Specifications of certain dimensions, expressed as thousandths of standard length, of 13 specimens from Cardinia Creek, Victoria

Feature	Range	$\bar{x}$	σ	V	N
Length to dorsal origin	688 - 750	725.3 ± 5.2	18.1 ± 3.7	2.5 ± 0.5	12
Length to dorsal termination	769 - 815	803.9 ± 4.7	15.6 ± 3.3	1.9 ± 0.4	11
Length to anal origin	658 - 729	692.2 ± 5.5	19.0 ± 3.9	2.7 ± 0.6	12
Length to anal termination	773 - 838	800.8 ± 5.8	19.1 ± 4.1	2.4 ± 0.5	11
Length to ventral origin	481 - 529	504.4 ± 4.3	14.3 ± 3.1	2.8 ± 0.6	10
Length of pectoral	113 - 142	126.2 ± 2.5	8.0 ± 1.8	6.3 ± 1.4	10
Length of ventral	67 - 95	84.2 ± 2.7	8.5 ± 1.9	10.1 ± 2.2	10
Length of caudal	148 - 200	174.1 ± 4.8	15.2 ± 3.4	8.8 ± 2.0	10
Head	201 - 283	219.6 ± 6.9	22.2 ± 4.7	10.1 ± 2.2	11
Snout	37 - 46	41.6 ± 0.7	2.4 ± 0.5	5.7 ± 1.2	12
Eye	69 - 88	78.8 ± 1.5	5.1 ± 1.0	6.5 ± 1.3	12
Interorbital	65 - 83	75.1 ± 1.9	5.6 ± 1.3	7.4 ± 1.8	9
Maximum depth	110 - 190	157.5 ± 7.5	25.0 ± 5.3	15.8 ± 3.5	11
Depth at vent	106 - 134	123.2 ± 2.4	8.0 ± 1.7	6.5 ± 1.4	11
Depth at hypural (without caudal ridges)	39 - 58	50.4 ± 1.4	4.5 ± 1.0	8.9 ± 1.9	11

TABLE 2

Brachygalaxias pusillus tasmaniensis subsp. nov. Specifications of certain dimensions, expressed as thousandths of standard length, of 14 specimens from *Marengo*, Waterhouse Estate, Dorset, Tasmania

Feature	Range	$\bar{x}$	σ	V
Length to dorsal origin	720 - 768	734.9 ± 2.5	9.2 ± 1.7	1.3 ± 0.2
Length to dorsal termination	792 - 844	820.4 ± 3.6	13.4 ± 2.6	1.7 ± 0.3
Length to anal origin	674 - 717	686.8 ± 2.8	10.6 ± 2.0	1.5 ± 0.3
Length to anal termination	784 - 830	810.4 ± 3.7	13.7 ± 2.6	1.7 ± 0.3
Length to ventral origin	468 - 534	496.6 ± 4.1	15.4 ± 2.9	3.1 ± 0.6
Length of pectoral	142 - 201	173.9 ± 3.8	14.1 ± 2.7	8.1 ± 1.5
Length of ventral	81 - 119	107.2 ± 2.5	9.4 ± 1.8	8.8 ± 1.7
Length of caudal	125 - 193	160.9 ± 4.6	17.2 ± 3.3	10.7 ± 2.0
Head	203 - 255	231.4 ± 3.5	13.1 ± 2.5	5.6 ± 1.1
Snout	38 - 54	45.8 ± 1.1	4.2 ± 0.8	9.1 ± 1.7
Eye	60 - 84	69.7 ± 1.7	6.4 ± 1.2	9.2 ± 1.7
Interorbital	61 - 96	85.0 ± 2.3	8.7 ± 1.7	10.3 ± 2.0
Maximum depth	163 - 219	192.8 ± 3.9	14.7 ± 2.8	7.6 ± 1.5
Depth at vent	150 - 180	164.0 ± 2.4	3.8 ± 1.7	5.3 ± 1.0
Depth at hypural (without caudal ridges)	57 - 82	70.7 ± 1.7	6.3 ± 1.2	8.9 ± 1.7
Minimum depth of caudal peduncle	106 - 145	126.6 ± 2.3	8.6 ± 1.6	6.8 ± 1.3
Length of longest dorsal ray	100 - 125	111.4 ± 2.2	8.1 ± 1.5	7.3 ± 1.4
Length of longest anal ray	104 - 129	117.6 ± 1.9	7.3 ± 1.4	6.2 ± 1.2

TABLE 3

Brachygalaxias pusillus flindersiensis subsp. nov. Specifications of certain dimensions, expressed as thousandths of standard length, of 15 specimens from Lackrana, Flinders Island, Bass Strait

Feature	Range	$\bar{x}$	σ	V
Length to dorsal origin	702 - 764	723.5 ± 4.4	17.1 ± 3.1	2.4 ± 0.4
Length to dorsal termination	783 - 837	810.3 ± 3.9	15.0 ± 2.7	1.9 ± 0.3
Length to anal origin	674 - 719	693.0 ± 3.2	12.6 ± 2.3	1.8 ± 0.3
Length to anal termination	778 - 823	797.3 ± 3.3	12.6 ± 2.3	1.6 ± 0.3
Length to ventral origin	483 - 534	504.7 ± 4.5	17.6 ± 3.2	3.5 ± 0.6
Length of pectoral	143 - 195	170.4 ± 3.7	14.3 ± 2.6	8.4 ± 1.5
Length of ventral	92 - 124	102.5 ± 2.1	8.3 ± 1.5	8.0 ± 1.5
Length of caudal	133 - 199	167.3 ± 4.4	17.2 ± 3.1	10.3 ± 1.9
Head	229 - 257	242.4 ± 2.8	10.9 ± 2.0	4.5 ± 0.8
Snout	44 - 68	57.1 ± 1.9	7.3 ± 1.3	12.9 ± 2.4
Eye	70 - 91	83.2 ± 1.6	6.2 ± 1.1	7.4 ± 1.4
Interorbital	74 - 91	81.8 ± 1.2	4.5 ± 0.8	5.5.± 1.0
Maximum depth	152 - 196	179.7 ± 3.5	13.6 ± 2.5	7.5 ± 1.4
Depth at vent	129 - 179	147.3 ± 3.1	12.0 ± 2.2	8.2 ± 1.5
Depth at hypural (without caudal ridges)	55 - 79	65.0 ± 2.9	11.2 ± 2.0	17.1 ± 3.3
Minimum depth of caudal peduncle	89 - 137	113.7 ± 3.5	13.5 ± 2.5	11.9 ± 2.2
Length of longest dorsal ray	91 - 131	110.0 ± 2.4	9.4 ± 1.7	8.6 ± 1.6
Length of longest anal ray	104 - 136	120.5 ± 2.4	9.3 ± 1.7	7.7 ± 1.4

TABLE 4

Brachygalaxias pusillus pusillus, *B. p. tasmaniensis*, *B. p. flindersiensis*. Specifications of certain ratios, and other derived dimensions, the latter expressed as the thousandths of standard length

Feature		Range	$\bar{x}$	σ	V	N
Snout in head	*B.p.p.*	4.6 - 6.8	5.30 ± 0.18	0.12 ± 0.06	11.5 ± 2.4	11
	B.p.t.	4.6 - 5.7	5.08 ± 1.12	0.42 ± 0.08	8.3 ± 1.6	14
	B.p.f.	3.4 - 5.1	4.22 ± 0.11	0.43 ± 0.08	10.1 ± 1.9	15
Snout in eye	*B.p.p.*	1.6 - 2.2	1.89 ± 0.48	0.15 ± 0.03	8.8 ± 1.8	12
	B.p.t.	1.3 - 1.8	1.52 ± 0.41	0.17 ± 0.03	10.1 ± 1.9	14
	B.p.f.	1.0 - 1.9	1.53 ± 0.07	0.27 ± 0.05	17.3 ± 3.3	15
Eye in inter-orbital	*B.p.p.*	0.9 - 1.0	0.96 ± 0.01	0.02 ± 0.00	1.8 ± 0.4	9
	B.p.t.	0.9 - 1.4	1.23 ± 0.04	0.15 ± 0.03	12.0 ± 2.3	14
	B.p.f.	0.9 - 1.2	0.99 ± 0.02	0.09 ± 0.02	9.2 ± 1.7	15
Pectoral-ventral interval in length of pectoral	*B.p.p.*	0.3 - 0.5	0.44 ± 0.01	0.03 ± 0.08	7.8 ± 1.8	10
	B.p.t.	0.6 - 0.7	0.63 ± 0.01	0.05 ± 0.01	8.1 ± 1.5	14
	B.p.f.	0.7 - 0.8	0.61 ± 0.03	0.12 ± 0.02	19.0 ± 3.7	15
Ventral-anal interval in length of ventral	*B.p.p.*	0.3 - 0.6	0.47 ± 0.02	0.07 ± 0.02	1.5 ± 0.3	12
	B.p.t.	0.4 - 0.7	0.57 ± 0.02	0.06 ± 0.01	11.3 ± 2.2	14
	B.p.f.	0.5 - 0.7	0.55 ± 0.01	0.06 ± 0.02	11.5 ± 2.3	15
Interval between anal and dorsal origins	*B.p.p.*	13 - 57	32.8 ± 3.8	13.0 ± 2.6	39.7 ± 9.3	12
	B.p.t.	38 - 62	48.1 ± 1.8	6.8 ± 1.3	14.1 ± 2.7	14
	B.p.f.	8 - 45	30.3 ± 3.5	13.4 ± 2.5	44.2 ± 9.5	15
Anal base	*B.p.p.*	78 - 134	110.1 ± 4.4	14.6 ± 3.1	13.3 ± 2.8	11
	B.p.t.	102 - 150	123.5 ± 3.5	12.9 ± 2.4	10.5 ± 1.1	14
	B.p.f.	89 - 121	104.3 ± 2.6	10.0 ± 1.8	9.6 ± 1.8	14

TABLE 5

Brachygalaxias pusillus pusillus, B.p. tasmaniensis, B.p. flindersiensis. Differences of means of 3 samples for some characters, expressed as thousandths of standard length: *t* values. An empty cell indicates a statistically non-significant value of *t* (P >0.05). The initial letter of the third element of the trinomial (*p, t, f*) identifies the subspecies yielding the (numerically) larger value. The figure in parentheses is the pooled number of specimens

Feature	*B.p.pusillus* versus *B.p.tasmaniensis*			*B.p.pusillus* versus *B.p.flindersiensis*			*B.p. tasmaniensis* versus *B.p.flindersiensis*		
Length of pectoral	9.39	*t*	(24)	8.55	*f*	(23)		—	
Length of ventral	5.89	*t*	(24)	5.16	*f*	(25)		—	
Head		—		8.31	*f*	(26)	2.38	*f*	(29)
Snout	3.31	*t*	(26)	6.75	*f*	(25)	3.73	*f*	(29)
Eye	3.81	*p*	(26)	2.06	*f*	(27)	5.60	*f*	(29)
Interorgital	2.83	*t*	(23)	3.06	*f*	(22)		—	
Maximum depth	4.33	*t*	(25)	2.79	*f*	(26)	2.57	*t*	(29)
Depth at vent	10.75	*t*	(25)	5.33	*f*	(26)	4.01	*t*	(29)
Depth at hypural (without caudal ridges)	9.79	*t*	(25)	3.94	*f*	(26)		—	
Minimum depth of caudal peduncle	No data			No data			2.91	*t*	(29)
Length to anal termination		—			—		2.59	*t*	(29)
Snout in head		—		5.15	*p*	(26)	5.31	*t*	(29)
Snout in eye	5.62	*p*	(26)	3.93	*p*	(27)		—	
Eye in inter-orbital	5.44	*t*	(23)		—		5.08	*t*	(29)
Pectoral-ventral interval in length of pectoral	8.70	*t*	(24)	4.51	*f*	(25)		—	
Ventral-anal interval in length of ventral	3.59	*t*	(24)	2.98	*f*	(25)		—	
Interval between anal and dorsal origins	3.66	*t*	(26)		—		4.29	*t*	(29)
Anal base	2.21	*t*	(25)		—		4.40	*t*	(29)

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NATIONAL MUSEUM
20 SEP 1971
OF VICTORIA

SEA TURTLES ROUND TASMANIA

by

R. H. GREEN

RECORDS OF THE
QUEEN VICTORIA MUSEUM

No. 38

EDITED BY W. F. ELLIS
DIRECTOR OF THE MUSEUM

SEA TURTLES ROUND TASMANIA

THE FIRST RECORD OF THE GREEN TURTLE *CHELONIA MYDAS* (LINNE, 175B) AND THE HAWKSBILL TURTLE *ERETMOCHELYS IMBRICATA BISSA* (RUPPELL, 1B35) FROM TASMANIAN WATERS

by

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Manuscript received 10/12/1970 *Published 21/5/1971*

ABSTRACT

A large *Chelonia mydas* (Linné, 1758) was caught on a hand line at Burnie, north-west Tasmania on 20 April 1959 but because of mistaken identity, the record remained obscure.

A small *Eretmochelys imbricata bissa* (Rüppell, 1835) was found dead on a beach on King Island, Bass Strait in December 1969. These two occurrences constitute the first records of the species from Tasmania and, as such, are probably the most southerly distributional record.

Scott and Mollison (1956) record the occurrence in Tasmanian waters of the leathery turtle *Dermochelys coriacea* (Linné, 1766) twice and the loggerhead turtle *Caretta caretta gigas* Deraniyagala, 1933 eleven times. Five additional occurrences of *Dermochelys coriacea* are recorded here.

INTRODUCTION

Specimens of chelonia are rarely collected from Tasmania though fishermen occasionally see them at sea. Lord and Scott (1924) record the first, a leathery turtle *Dermochelys coriacea*, secured in Fortescue Bay on the south-east coast of Tasmania in March 1889. Scott and Mollison (1956) recorded a sight record of this species from the same locality about 1945 and the occurrence of the Indo-Pacific redbrown loggerhead turtle *Caretta caretta gigas* based upon the examination of three specimens and the reported sightings of eight others.

Nishimura (1967) does not recognise subspecific separation of *Caretta caretta gigas* as suggested by Deraniyagala (1933) and accepted by many authors, including those who have recorded loggerheads from Tasmania. *Caretta caretta* occurs typically in the temperate zones of both hemispheres, being replaced in subtropical zones by the olive loggerhead turtle *Lepidochelys olivacea* Eschscholtz, 1829.

CHELONIA MYDAS (LINNE, 1758)

The Tasmanian daily newspaper, "The Advocate" of 21 April 1959 published a photograph of a large turtle and some accompanying text stating that the turtle was hooked by Mr. Dick Austin on the previous day while he was fishing "for trevally" with a light nylon line from Ocean Pier at Burnie (land district of Wellington/Devon). The turtle was reported to have "snapped up the bait" and, after a rope was attached, it was hauled to the wharf

by six men. There it was photographed and assessed to weigh 500 pounds (227 kg.) and to measure five feet six inches in length (1676 mm). It was stated to nave "wasted no time in getting under way again when he was thrown back into the sea."

It was identified then as a leathery turtle and this mistake remained unnoticed until 1970 when, in files in the Queen Victoria Museum, I found the newspaper cutting. After careful examination of several excellent photographs kindly provided by the Assistant Manager of "The Advocate," I am confident in identifying it as a green turtle *Chelonia mydas*. This opinion is supported by Dr. H. G. Cogger, Curator of Reptiles and Amphibians of the Australian Museum, Sydney who, after examining one of the photographs, wrote "The turtle shown in the photograph is almost certainly a Green Turtle *(Chelonia mydas)*. Its long tail would suggest that it was a male."

This constitutes the first recorded occurrence of the species in Tasmania and probably the most southerly record. McCann (1966) records its occurrence in New Zealand on five occasions but all were from more northerly latitudes.

ERETMOCHELYS IMBRICATA BISSA (RUPPELL, 1835)

In December 1969 a turtle in an advanced state of decomposition was collected on a beach at Long Point, Whitemark, Flinders Island, Bass Strait by Constable Reg Chatwin. He cleaned away as much of the body as possible and allowed the united carapace and plastron to dry. This was forwarded to the Queen Victoria Museum on 25 June 1970 where it was determined as a hawksbill turtle *Eretmochelys imbricata* and deposited in the collection (register number 1970/3/9). This is the first record of the species from Tasmanian waters and probably its most southerly record.

Gadow (1958) gives its distribution as "all the tropical and subtropical seas." Worrell (1963) states "Occurs in shallow coastal waters as far south as Broken Bay, where I have collected occasional specimens, to southern New South Wales. Turtles of all kinds, however, are rare south of the torrid zone."

Gadow (1958) gives the largest shell recorded as measuring 850 mm. in length. Pritchard (1969) gives 33.1 inches (838 mm.) as the mean carapace length of nesting hawksbill turtles on Guvana and the heaviest specimen he weighed was 165 pounds (74.47 kg).

The overall measurements of the dried carapace of the Flinders Island specimen are 330 mm. length and 260 mm. width. It is distorted slightly by an old wound suggesting the bite of a predator. This has resulted in the fifth and sixth margin epidermal plates being missing and the fourth and seventh damaged. The wound had completely healed and does not appear to have been the cause of death.

McCann (1966) gives three records from New Zealand.

DERMOCHELYS CORIACEA (LINNE, 1766)

1. On 5 April 1957 a female specimen was collected at sea off Bridport (land district of Dorset) by Messrs. N. & R. Lade and brought to Bridport where it was transported to the Queen Victoria Museum. Its overall length was about five feet (1524 mm.) and its weight about 850 pounds (385.7 kg). The skeletal remains are held in the Queen Victoria Museum (register number 1970/3/11). At least three turtles were reported to have been seen off Brid-

port in the weeks previous to its capture.

2. On 14 January 1969 Mr. Jack Mallison found a large turtle entangled in his fishing net off Binnalong Bay (land district of Dorset). It was nearly dead and was shot to facilitate its disentanglement. Several photographs were taken by Mrs J. Kerr who kindly allowed me to view them, providing confirmation of Mr. Mallison's identification as *Dermochelys coriacea*. Shortly afterwards it washed up on Binnalong Bay beach.

3. On 13 February 1959 a note in the Tasmanian daily newspaper "The Examiner" reported the presence of a dead turtle on the beach near Denison River at Bicheno (land district of Glamorgan). It was stated to be approximately five feet six inches (1676 mm.) long and three feet six inches (1067 mm.) wide. Mr. E. O. G. Scott visited the site on the following two days and was informed that it had been there for at least two weeks. He identified it as *Dermochelys coriacea* and buried the remains in the sand to recover the bones later.

4. Professor B. H. Brattstrom of California State College has kindly provided me with the following information. On or about 29 November 1966 a large *Dermochelys coriacea* was killed by fishermen and brought to the rocks at Killiecrankie Bay, Flinders Island, Bass Strait, after it had become entangled in fishing gear and buoy lines. Professor Brattstrom inspected it on 3 December 1966, took photographs, collected barnacles from its back and removed its head for the skull which is now lodged in the Californian State Fullerton Collection (register number 4237). He estimated the carapace as about five feet (1524 mm.) long.

5. On 20 February 1969 Mr. R. L. James, writing in "Letters to the Editor" in the Tasmanian daily newspaper "The Examiner" stated "A very large (and very dead) turtle has been washed up on the beach at Four Mile Creek, about four miles (6.44 km.) south of Falmouth" (land district of Cornwall). Three days later, Mr. E. O. G. Scott, Honorary Ichthyologist, Queen Victoria Museum, visited the site and identified the remains as those of *Dermochelys coriacea*. The head was missing and the remains were in a rather advanced stage of decomposition. It had been stranded a little above normal high tide level. Scott noted the carapace as 1330 mm. in length and 800 mm. in width. He salvaged some flipper bones and these have been deposited in the Queen Victoria Museum collection (register number 1969/3/9).

6. On 22 March 1969 a male *Dermochelys coriacea* was collected seven miles (11.26 km.) north from Stanley (land district of Wellington) by Mr. Vic. Hardy after it became entangled in shark line. It was towed to Stanley from where it was transported to the Queen Victoria Museum. Its overall length was about seven feet six inches (2286 mm.) and its weight about 900 pounds (409 kg).

This specimen has been moulded and cast in fibre glass for display in the Museum. The skeletal remains were preserved and deposited in the Museum collection (register number 1970/3/12).

McCann (1966) gives nine recorded occurrences from New Zealand.

CARETTA CARETTA GIGAS DERANIYAGALA, 1933

Scott and Mollison (1956) include a footnote without details, mentioning a turtle, believed to be this species, found in 1951 on King Island, Bass Strait but which came to their notice too late to be incorporated in the text of their paper.

The following extract, published in the Tasmanian daily newspaper "The Mercury" on 12 March 1951 probably refers to this turtle: "A King Island fisherman found a huge sea turtle tangled in the buoy line of one of his crayfish pots on Saturday. King Island residents estimate it weighed about a ton (1019.2 kg.), and measured about six feet (1829 mm.) long by four feet (1219 mm.) wide. The fisherman (Mr. S. Darby) found the turtle caught by the neck and front flippers. He took the line aboard his boat, Pattina, and towed the turtle to Currie Harbour where residents used a motor truck to pull it onto the beach. Fishermen killed the turtle and cut it up for fish bait. The turtle is the biggest King Island residents remember.

A turtle caught off New Year Island a few years ago was not as big."

I have been unable to find any further reference to the last mentioned turtle. The location is off the east coast of King Island.

McCann (1966) gives six occurrences from New Zealand.

COMMENTS

It is noteworthy that, with the exception of no. 4, all *Dermochelys coriacea* for which data are available have been recorded in or near the month of March. Of the eleven occurrences in New Zealand (McCann, 1966) seven were within the period January to May and one in October. The remaining three are undated.

This bias is only slight for the other species. It is also of interest that, of the twelve records given by Scott and Mollison (1956) covering the period 1945-1955, eleven were of *Caretta caretta* and one of *Dermochelys coriacea*. Since August 1955, there have been no records of *Caretta caretta* from Tasmania, but five *Dermochelys coriacea* were collected in the period 1957 - 1969. McCann (1966) gives five records of *Caretta caretta* from New Zealand during the eight years 1949 to 1956 but no subsequent occurrences.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to Mr. W. J. Harris, Assistant Manager of "The Advocate," Burnie for providing the photographs of *Chelonia mydas* and to Mr. E. O. G. Scott, Honorary Ichthyologist, Queen Victoria Museum, for his field notes, advice and assistance.

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FURTHER NOTES ON FLINDERS ISLAND BIRDS

AN APPENDIX TO THE FAUNA LIST

by

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Manuscript received 28/4/1971 *Published 24/5/1971*

ABSTRACT

Since the publication in June 1969 of The Birds of Flinders Island (Green 1969) further material received by the Queen Victoria Museum has established the occurrence of ten additional bird species and two fish species from the area.

BIRDS

During the winters of 1969 and 1970, sea bird mortality in Bass Strait appeared to be heavier than usual, possibly due to a dark bituminous material found adhering to the feathers of some beachwashed birds. Similar mortality was detected during the same period on the west coast of King Island in western Bass Strait (Templeton 1970).

As a result of patrols by G. D. F. Smith, J. Whinray and D. M. Rhodes, the following birds have been salvaged and forwarded to the Queen Victoria Museum where they have been registered into the collections. Those with a bracketed asterisk (*) are species not previously collected from Flinders Island. "N" is added where the species is recorded for the first time in this locality.

65. White-faced Storm-petrel *Pelagodroma marina*. Two Whitemark 29 February 1971.

68. Fluttering Shearwater *Puffinus gavia* (*)N. One Long Point 18 September 1969; one Whitemark April 1970.

70. Sooty Shearwater *Puffinus griseus* (*)N. One Whitemark January 1971.

74. Silver-grey Petrel *Fulmaris glacialoides* (*)N. One Locotta 25 October 1970.

79. Giant Petrel *Macronectes giganteus* (*). One Locotta 3 July 1969. This bird had been banded as a nestling on Signy Island, South Orkney, Antarctica in March 1969.

80. Cape Petrel *Daption capense*. One Long Point 18 September 1969; one Marshall Bay 20 July 1969.

82a. Medium-billed Prion *Pachyptila salvini* (*)N. Three Marshall Bay 20 July 1969; one Whitemark 16 July 1969; one Marshall Bay 20 July 1969; one Marshall Bay 31 July 1969; five Marshall Bay 22 July 1970; one Whitemark 3 September 1970.

83. Fairy Prion *Pachyptila turtur*. One Whitemark 16 July 1969; three Marshall Bay 20 July 1969; one Marshall Bay 10 August 1969; one Long Point 18 September 1969; one Marshall Bay 20 July 1970; five Marshall Bay 22 July 1970.

84. Dove Prion *Pachyptila desolata* (*)N. One Whitemark 17 July 1969; three Marshall Bay 31 July 1969; five Marshall Bay 22 July 1970.

84a. Thin-billed Prion *Pachyptila belcheri*. One Marshall Bay 18 July 1969; one Marshall Bay 20 July 1969; three Marshall Bay 31 July 1969; two Marshall Bay 20 July 1970; six Marshall Bay 22 July 1970.

88. Black-browed Albatross *Diomedea melanophris*. One Long Point 18 September 1969; one Whitemark October 1970.

89. Yellow-nosed Albatross *Diomedea chlororhyncha* (*)N. One Marshall Bay 20 July 1969; one Long Point 18 September 1969.

90. Grey-headed Albatross *Diomedea chrysostoma* (*)N. One Marshall Bay 31 July 1969; one Lady Barron 25 October 1969; one Marshall Bay 22 July 1970.

91. White-capped Albatross *Diomedea cauta* (*). One Long Point 18 September 1969.

215. White-eyed Duck *Aythya australis* (*). One (register no. 1971/2/21) was shot on Brodies Lagoon on 12 March 1971 and forwarded to the Museum for identification. It was flying with Black Ducks *A. superciliosa*.

216. Blue-billed Duck *Oxyura australis*. D. Rhodes had two pairs under observation on lagoons on the east coast of Flinders Island during the latter half of 1970 and early 1971. At least one pair nested and was seen by Rhodes on several occasions during February and March escorting small ducklings.

249. Barn Owl *Tyto alba* (*)N. A specimen (register no. 1970/2/60) was found washed up on the beach on Chappell Island by David Milledge on 28 July 1970.

306. Blue-winged Parrot *Neophema chrysostoma* (*)N. Rhodes has seen small flocks feeding on grasslands on several occasions. In October 1968 they were living in the Lackrana area where, on 13 October, he found a dead bird (register no. 1968/2/247) which was of this species.

571. Forty-spotted Pardalote *Pardalotus quadragintus* (*)N. The presence of this bird was discovered in Smith's Gully in 1970 by Ian Abbott and David Milledge. A specimen (register no. 1970/2/89) was secured in November 1970.

FISH

I am indebted to Peter, Robert and Christopher Rhodes for the collection of fish, which are additional to those recorded previously.

Pigmy Perch *Nannoperca australis*. (Register no. 1970/5/25) collected from drains at Lackrana in September 1969. This is a new subspecies, described by Scott in *Pap. Proc. Roy. Soc. Tasm.*, Vol. 105 (in press).

Minnow *Brachygalaxias pusillus flindersiensis*. (Register no. 1969/5/25) collected from drains at Lackrana in June 1969. This is a new subspecies (Scott 1971).

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20 SEP 1971
OF VICTORIA

THE BIRDS OF KING ISLAND

by

R. H. GREEN
QUEEN VICTORIA MUSEUM

and

A. M. McGARVIE
EGG LAGOON, KING ISLAND

RECORDS OF THE
QUEEN VICTORIA MUSEUM
No. 40

EDITED BY W. F. ELLIS
DIRECTOR OF THE MUSEUM

THE BIRDS OF KING ISLAND

WITH REFERENCE TO OTHER WESTERN BASS STRAIT ISLANDS AND ANNOTATED LISTS OF THE VERTEBRATE FAUNA

by

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Manuscript received 12/2/69.
amended 26/5/71.

Published 9/8/71.

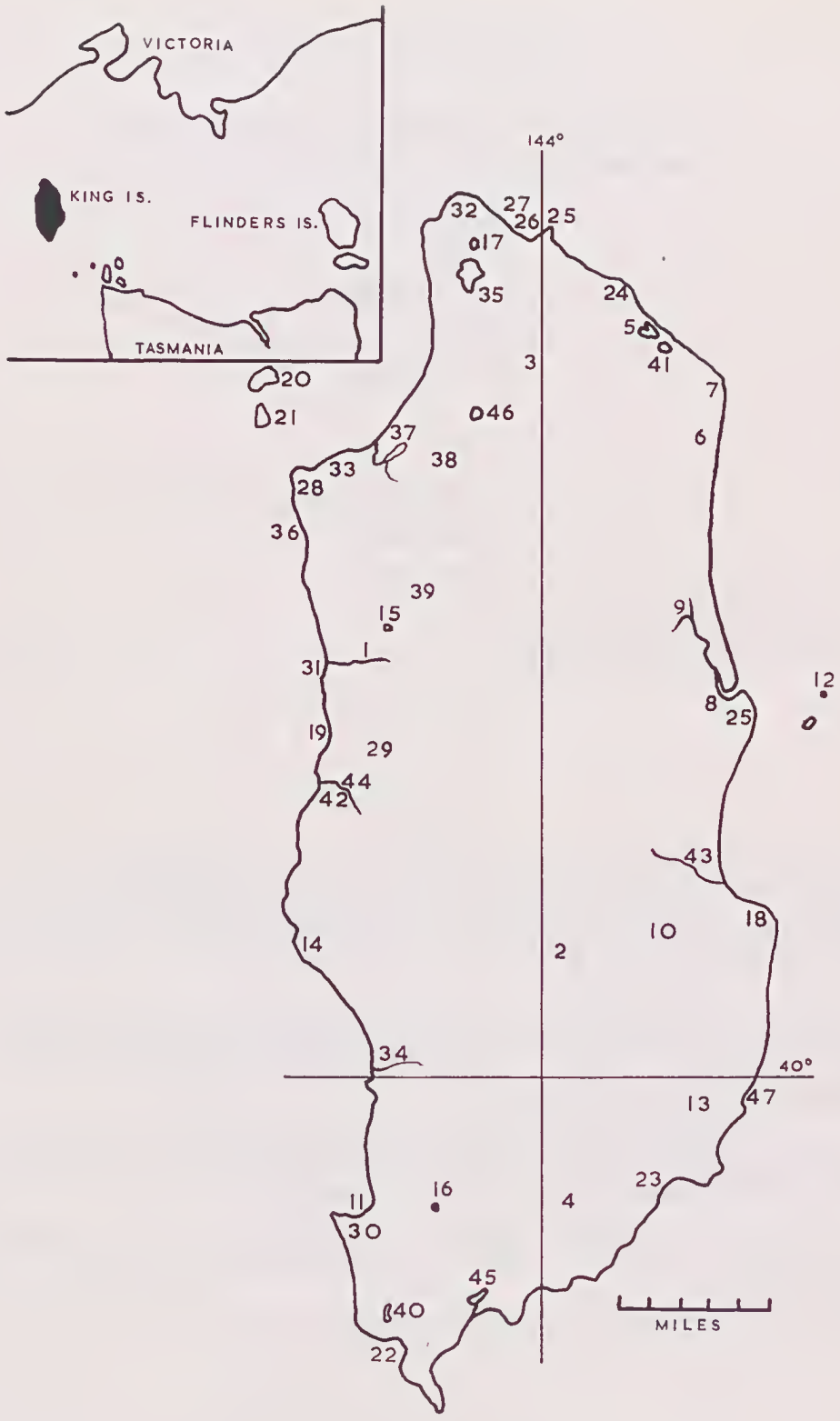
ABSTRACT

A brief study of the birds on King Island was undertaken by the Queen Victoria Museum during three visits in 1967 and 1968 when 224 bird specimens were collected. One of us (A.M.McG) has resided locally and kept ornithological records for ten years. As a result, 143 bird species are recorded from King Island and its coastal waters. Seventy-five species have been found to breed locally.

Habitat alteration since the invasion of European man has been extensive and severe with the result that one bird species has become extinct. several species have disappeared from the island and others have been reduced considerably in numbers. Species dependent on grassland have benefited from pastoral improvement.

Several mainland Australian species which do not occur in Tasmania are seen regularly on King Island while some sedentary species which occur in south-eastern Australia and Tasmania are absent.

Observations on mammals, amphibians and reptiles are also recorded. A list of the gut contents of the birds collected during the study is given in the appendix.


VICTORIA
KING IS.
FLINDERS IS.
TASMANIA
144°
40°
MILES

West
~~East~~ coast pastoral country looking north from Pass River. The river flows westwards and at this point is about one and a half miles from the sea. Nankeen Night Herons nest in the trees in the foreground.

King Island, western Bass Strait. Places mentioned in the text are as follows:

1 Pass River
2 Pegarah
3 Egg Lagoon
4 Mt. Stanley
5 Lake Martha Lavinia
6 The Nook
7 Lavinia Point
8 Sea Elephant
9 Sea Elephant River
10 Forestry Reserve
11 Fitzmaurice Bay
12 Councillor Island
13 Yarra Creek
14 Currie
15 Tatham's Lagoon
16 Pearshape Lagoon
17 Little Cask Lake
18 Naracoopa
19 Porky Beach
20 New Year Island
21 Christmas Island
22 Surprise Bay
23 Grassy
24 Boulder Point
25 Point Cowper
26 Rocky Cape
27 Disappointment Bay
28 Whistler Point
29 Loorana
30 Cataraque Point
31 Unlucky Bay
32 Cape Wickham
33 Yellow Rock
34 Ettrick River
35 Lake Flannigan
36 Duck Bay
37 Yellow Rock River
38 Yambacoona
39 Reekara
40 Bowling's Lagoon
41 Penny Lagoon
42 Porky Creek
43 Fraser River
44 Porky Lagoon
45 Big Lake
46 Bob's Lagoon
47 City of Melbourne Bay

INTRODUCTION

King Island lies in the western approaches to Bass Strait, approximately 55 miles south south-east of Cape Otway, on the Victorian coast and 53 miles north-west of Cape Grim, north-west Tasmania. It was joined to Tasmania and Victoria by landbridge when the sea level dropped during the Pleistocene (Jennings 1959*a*) and in Tertiary times (Bock and Glenie 1965). Its present isolation makes the affinities of the fauna of particular interest, and its geographical position makes it an obvious "stepping stone" for birds which migrate between Victoria and Tasmania. Peron (1804) gives some brief but interesting details of the island and its fauna at the beginning of the nineteenth century before the local fur seals and elephant seals were annihilated.

The Field Naturalists' Club of Victoria conducted an expedition to King Island in November 1887, the party comprising 27 men of varying interests. Almost three weeks were spent on and round the island during which the tracks of the party on land were estimated to cover 160 to 170 miles, much of which was in difficult country. A. J. Campbell (1888) gives an account of this expedition with lists of the mammals, birds, reptiles, amphibians, insects and flora observed, many specimens of which were collected and preserved. A. G. Campbell (1903) expanded the bird list after a visit in November 1902. The Australian Ornithologists' Union visited the island during their Bass Strait expedition in 1908 (White 1909). The ecology and evolution of the avifauna of the area are discussed by Ridpath and Moreau (1966). The present publication is the result of an attempt by the authors to assess the status of the vertebrate fauna, as alteration to the environment will no doubt produce even greater changes in the near future.

METHODS AND SOURCES OF DATA

Green made three visits to King Island: alone 11-15 December 1967; with J. W. Swift (technical assistant) 19 February - 1 March 1968; and alone 23 September - 2 October 1968. The visits in December and September were principally exploratory but some collecting was undertaken. The February visit was devoted mainly to collecting in the areas of the Pass River and Pegarah, with particular attention given to the sedentary birds. A total of 224 bird specimens were collected. Local residents were interviewed on all three visits.

Birds and mammals were collected mainly by shooting and netting, the surplus netted birds being released unharmed after examination. Standard measurements, breeding and age data, stomach contents and ephemeral colours of the specimens were recorded and searches made for both external and internal parasites. All material and data collected has been lodged with the Queen Victoria Museum and registered numbers quoted are for that institution unless otherwise stated. A number of species were observed and recorded in addition to those collected. Some additional material, principally beach washed specimens, have been collected by local residents and deposited with the Queen Victoria Museum and the National Museum of Victoria.

McGarvie has lived at Egg Lagoon since 1958. He has studied the birds of the island and has kept records of sightings and migratory movements over the years. Mr. John Courtney of Swan Vale, N.S.W. has provided

his notes and knowledge of the fauna of the island. Mr. Malcolm Templeton of Loorana has forwarded results of his observations and numerous beach-washed specimens collected since 1968.

The bird nomenclature follows that of the R.A.O.U. Checklist (1926 edition with subsequent amendments. Names are followed by * if the occurrence of the species is undoubted by the present authors and by (*) if one or more locally collected examples are held in the collection of the Queen Victoria Museum. B is added if the species is known to be a local breeder. If the name is not followed by an asterisk the present authors consider the occurrence of the species now doubtful.

It is natural that time will produce additions to the present list especially from the migratory birds. The lack of references to oceanic species is the result of limited collecting and observations by competent ornithologists at sea.

HABITAT

King Island measures approximately 40 miles from north to south and sixteen miles at the widest point. The terrain is low and undulating, the highest point being Mount Stanley in the south-east which is 500 feet above sea level. The soil is variable but mostly light, ranging from sand to sandy loam (Stephens and Hosking 1932) and much of the coastal region is stabilised dunes formed during the Holocene (Jennings 1959*b*). Stephens and Hosking (1932) give some details of early settlement and land development, climatic features, geology, general physiography and a description of the soils. Jennings (1959*b*) discusses the coastal geomorphology and changing sea levels.

A. J. Campbell (1888) gives a good account of the habitat at that time, a notable feature of which was the dense wet sclerophyll forest of the south-east, most of which has long since disappeared. Even at this time of early settlement, Campbell (1888) referring to an area in the centre of the island states "Eastwards is the remains of a singular ancient forest, indicated by blanched, naked tree-barrels." Fifteen years later, A. G. Campbell (1903) states in part "the face of King Island has so altered during the last fifteen years that it may not be long before some forms are driven away or killed out, as a result of the opening up of the land for dairy farming and cattle rearing. Year by year the native timber (eucalyptus) is becoming less; even now it is a difficult matter to get sufficient for fencing purposes, and the only large tracts on the island, along the east coast, have been decimated by bush fires."

Campbell's 1903 forecast unfortunately has come true as all that now remains in evidence of the once splendid forests are a few huge, decaying eucalypt (*E. globulus*) stumps, some still standing to a height of 100 feet or more and some minor areas which have survived along water courses where the terrain has not been suitable for pastoral development or where some far-sighted resident has conserved a few acres. The disappearance of those forests likewise has been accompanied by the disappearance of some animal species and drastic reduction of others which are dependent on this habitat for survival.

Most of the country remaining undeveloped is in the western part of the island, much of which generally is considered poor and not economical for pastoral improvements. However, modern farming is helping to convert

to introduced grasses, areas which a few years ago would not have been considered worthwhile. Typical of this is an area to the south of Lake Martha Lavinia which at present supports a scrub-like habitat, the height of which is influenced by fires and in places may stand to fifteen feet. Principal vegetation includes stunted manna gum *Eucalyptus viminalis* , swamp bull-oak *Casuarina monilifera* , honeysuckle *Banksia marginata*, river wattle *Acacia mucronata*, manuka *Leptospermum scoparium*, smooth tea-tree *L. laevigatum*, pink swamp heath *Sprengelia incarnata*, common heath *Epacris impressa*, pink bearded heath *Leucopogon ericoides*, bracken *Pteridium esculentum*, parrot pea *Dillwynia floribunda*, guinea flower *Hibbertia fasciculata*, narrow sword rush *Lepidosperma elatior*, tassel cord-rush *Restio tetraphyllus*, native mistletoe *Cassytha pubescens*, dodder *Cuscuta tasmanica*, *Patersonia* sp. and a rush, possibly *Hypolaena* sp.

Between this scrubland and the east coast is a narrow stretch of dense wet sclerophyll forest known locally as The Nook and, though little more than a few hundred yards in width, it extends almost from Lavinia Point to Sea Elephant and follows a swampy watercourse which is a tributary to the Sea Elephant River.

Some parts of this habitat still appear to be in an original condition and, though fire has at times encroached in places, the wet understorey has protected much of it from destruction. On the northern extremity, near Lavinia Point, is a good area of eucalypt regeneration now about fifteen feet high and offering the possibility of improvement and expansion if protected. From the Sea Elephant River to Lavinia Point is one of the best natural areas on the island and much of it has recently been proclaimed a nature reserve.

The forestry reserve near Pegarah comprises 2470 acres which is managed by the Tasmanian Forestry Commission for the provision of fencing and other commercial timbers. As at the end of 1968, 450 acres were under *Pinus radiata* plantation, 734 acres were under eucalypts, mostly introduced *Eucalyptus obliqua* but including some areas of natural regrowth of *E. ovata*, *E. globulus* and *E. viminalis*. Of the remaining area about 200 acres are considered suitable for planting to pines, the remainder being poor soil type not considered worth development at present (pers. com. J. Peterson). The undeveloped area carries dense scrub growing to 25 feet and includes *Eucalyptus* spp. regrowth, prickly moses *Acacia verticillata*, river wattle *A. mucronata*, blackwood *A. melanoxylon*, honeysuckle *Banksia marginata*, lancewood *Phebalium squameum* , manuka *Leptospermum scoparium*, pink bearded heath *Leucopogon ericoides*, bracken *Pteridium esculentum* and *Monotoca scoparia*. The area is cut by several deep gullies in which the indigenous eucalypts are dominant, with some standing to well over 100 feet.

BIRD SPECIES LIST

King Island Emu *Dromaius minor* Extinct: A description and details of habitats of the King Island Emu was obtained by the French naturalist Péron during the visit of the Baudin Expedition in December 1802. At the time of their visit, the weather was very bad and the party was unable to see emus except the carcases of several which the sealers had hung up for food.

A schedule of questions drawn up by Peron and answered by the resident sealers was published by Milne-Edwards and Oustalet (1899) and later by Brasil (1914). This gives some insight into the life and habits of the bird and indicates that it was smaller than the mainland species, being about four and a half feet high (1365 mm) and weighing up to 50 pounds(22.7 kg)

The plumage is stated to have been "quite black" in the adults.

Alexander (1921) has pointed out that Lieutenant Murray, of the "Lady Nelson", recorded in his log several allusions to the animals and birds of the island, including references to the emu. These observations were made in January 1802, eleven months before Péron's visit.

Peron (1804) includes illustrations (plates 36 and 41 drawn by C. A. Lesueur) of the Kangaroo Island emu. Mathews (1911) considers this incorrectly captioned, and he believed the standing bird to be of King Island origin. Brasil (1914) presents a case contradicting Mathews views and supporting the accuracy of the original caption.

Serventy (1967) has reproduced Peron's plate 36 as the "Black Emu of King Island (*Dromaius ater*)" and points out that Dr. Christian Jouanin (Natural History Museum, Paris) demonstrated in 1959, "that the mounted specimen of the dwarf black emu in their collection, which had hitherto been believed to be from Kangaroo Island, South Australia, originated in reality from King Island." There is no record of when the King Island emu became extinct but it appears to have been soon after the arrival of the commercial sealers in 1802 (Brasil 1914). They hunted it with trained dogs and used the meat to supplement their diet.

In addition to the mounted specimen mentioned above, a quantity of bones and egg fragments have been collected over the years from "wind blows" in the sandy soils. Some of this material is now in the Queen Victoria Museum. Spencer and Kershaw (1910*a*) describe a considerable accumulation of bones in various collections, most of which had been found on an area of sand dunes in the extreme south of the island (see their plate 1.). They demonstrate that *D. minor* was smaller in every feature than *D. novaehollandiae* of mainland Australia. For example, the femurs of adults range between 140 mm. and 180 mm. compared to 217 mm. to 243 mm. in *D. novaehollandiae*. Their measurements of other bones approximate this bias.

It was this character which, four years previously, prompted Spencer (1906) to describe it as a distinct species.

3. Rockhopper Penguin *Eudyptes chrysocome* (*). Campbell (1888) records a specimen collected during the visit of the Field Naturalist Club of Victoria (F.N.C.V.) in November 1887. Sharland (1958) records one specimen from Tasmania. Two large penguins were found dead on Porky Beach, King Island during 1970. One (1970/2/61) collected on 12 July, has been determined as *E. c. mosleyi*, a juvenile male estimated at six to 12 months old. This subspecies comes from the Indian and Atlantic Ocean colonies (pers. com. K. G. Simpson). The other specimen, (1970/2/58) collected on 4 August has been spirit preserved and still awaits determination. The scarcity of records indicates that the large penguins rarely occur in these waters.

5. Little Penguin *Eudyptula minor* *B. Common in adjacent waters. There is a rookery of about 2 acres at Fitzmaurice Bay and several smaller ones on the north coast. Councillor Island also supports a large rookery. In July 1970 one was found dead on Porky Beach. It had been banded as a nestling on Phillip Island, Victoria on 20 December 1969. (pers. com. M. T. Templeton)

9. Stubble-quail *Coturnix pectoralis* (*)B. Common in area of crop and grassland.

10. Brown Quail *Synoicus ypsilophorus* *. Very rare. McGarvie has seen only two individuals on the island.

12. King Quail *Excalfactoria chinensis* Several birds were caught at Pegarah and Yarra Creek about 1965 but it has not been possible to establish if they were of a natural population or aviary escapees.

14. Painted Quail *Turnix varia* *B. Fairly plentiful in the ferny areas and found breeding at Egg Lagoon. (A.M.McG)

34. Common Bronzewing *Phaps chalcoptera* * Rare on King Island. McGarvie (in company with J. Courtney) first positively identified this bird at the Nook in March 1967 and has since seen it on several occasions. Templeton saw one on the roadside near Currie on 14 July 1969.

35. Brush Bronzewing *Phaps elegans* (*)B. Common throughout the island and often seen and heard in or near to the patches of tea tree and scrub growing along the creeks or lagoon edges. Individuals and pairs were regularly flushed from the access roads in the forestry reserve. Collected specimens were found to have been feeding on subterranean clover seeds and other seeds of somewhat similar appearance. McGarvie found nests of this species situated on the ground. Templeton found several nests with eggs and small young placed in old night-heron's nests at Pass River on 10 September 1969.

45. Lewin Water-rail *Rallus pectoralis* (*). Occasionally seen throughout the island. McGarvie has seen individuals in his garden on three occasions in recent years. Templeton collected a road killed specimen (1970/2/19) at Loorana in April 1970.

46. Banded Landrail *Hypotaenidia philippensis* *. McGarvie has occasionally seen and heard this bird on the east coast in the vicinity of The Nook and on nearby Councillor Island.

56. Dusky Moorhen *Gallinalu tenebrosa* *B. Two were present on Tatham's Lagoon during Green's visit in December. In February the lagoon was almost dry and, though other water birds were still plentiful, the moorhens could not be found. McGarvie (1965) has found this species on Tatham's Lagoon at other times. Templeton has provided us with the following observations: 19 January 1969, six on a lagoon at Yambacoona; 9 August 1969 two at Pearshape Lagoon; 31 October 1969, two at Porky Creek; 29 April and 7 May 1970, one subadult and two adults at Porky Creek; 15 June 1970, five at Porky Creek; 15 September 1970, one was flushed from a nest at Clemons Lagoon near Loorana. The nest was placed in limbs near the waters edge and was found to contain four eggs.

    This bird has not been recorded from Tasmania though it does occur on Flinders Island (Green 1969)

58. Eastern Swamphen *Porphyrio porphyrio* (*)B. Plentiful on the tea tree lined swamps and lagoons throughout the island where it nests among the rushes and in the tea tree scrub. Eggs and half grown young were found by Green in December. Despite the dryness of the summer and receding water level in the lagoons during February, their numbers appeared unaltered.

59. Coot *Fulica atra* *B. Usually plentiful on the larger lagoons. In December several dozen were present on most such expanses of water. About 70 were counted on Pearshape Lagoon where a pair were observed tending at least two small young. A pair were present on Tatham's Lagoon but these had abandoned the area by the following February. Green observed one gathering nesting material at Tatham's Lagoon on 26 September and the Tatham brothers recall it breeding there on several occasions. Templeton found about 100 on Clemon's Lagoon, near Loorana, on 2 July 1970, and about 200 on Bob's Lagoon, near Yambacoona, on 12 July 1970.

62. Hoary-headed Grebe *Podiceps poliocephalus* *B. Usually plentiful on the lagoons throughout the island. In December Green found dozens on most inland waters. About 100 were present on Little Cask Lake and breeding has apparently just commenced. No young could be seen but six nests containing clutches of two or three eggs were found within thirty yards of the shore. Flotation tests showed them to be relatively fresh in most instances. Several platforms of green weed appeared ready for eggs. Breeding was not noticed on any other waters but McGarvie found them breeding on Pearshape Lagoon in October 1961. Birds were present on Little Cask Lake at the end of September but they had not commenced to nest.

65. White-faced Storm-petrel *Pelagodroma marina* (*). Templeton collected a beachwashed specimen (1969/2/95) on Porky Beach on 17 August 1969.

68. Fluttering Shearwater *Puffinus gavia* (*). Templeton collected a fresh beachwashed specimen on Porky Beach on 20 October 1969.

71. Short-tailed Shearwater *Puffinus tenuirostris* *B. Very numerous in the adjacent waters during the summer months. Many hundreds were visible seaward from Martha Lavinia beach during Green's visit in December and similar sightings were made from Naracoopa on 29 September. New Year Island and Christmas Island once supported extensive rookeries but on New Year Island the rookery area is now exposed sand, possibly as a result of overstocking with sheep. It has been deserted by the birds. (pers. com. M. T. Templeton) Breeding on the mainland of King Island was once unknown. "The King Island News" of 1 April 1970 records some memories of the islands oldest resident, Mr. Hickmott Grave. He states that in his youth there were "no mutton bird" *(P. tenuirostris)* rookeries on King Island but a large rookery was worked on nearby New Year Island. This rookery was expanding about a chain a year at the beginning of this century. Eventually rookeries were established on King Island, first at Stokes Point and, later, just south of Wickham. In recent years at least a dozen rookeries have been established. The largest are at Surprise Bay and just south of Grassy. Each of these cover as much as 200 acres. Other rookeries are known at Boulder Point, Point Cowper, near Lake Martha Lavinia, at Rocky Cape and several places in Disappointment Bay, Whistler Point, on the coast west of Loorana, and on Cataraque Point. All evidence indicates that the rookeries are continuing to expand despite the annual harvest of young birds taken by the local residents for human consumption.

73. Grey Petrel *Procellaria cinerea* (*). Templeton collected a beachwashed specimen (1970/2/38) on Porky Beach on 12 July 1970.

74. Silver-grey Petrel *Priocella antarctica* *. A single beachwashed specimen was salvaged by McGarvie at Lavinia Point on 14 November 1959 and sent to the National Museum of Victoria. (McGarvie 1965)

75. Great-winged Petrel *Pterodroma macroptera* (*). A beachwashed specimen was found by Templeton on Porky Beach in the first week of August 1968 and sent to the National Museum of Victoria. On 22 June 1969, he collected another decomposed specimen (1969/2/42) in the same area.

77. White-headed Petrel *Pterodroma lessonii* (*). As a result of regular patrols along Porky Beach, Templeton collected two (1969/2/55 and 57) on 12 July 1969, one (1969/2/70) on 8 July 1969, two (1969/2/89 and 90) on 17 August 1969 and one (1970/2/20) on 12 July 1970.

79. Giant Petrel *Macronectes giganteus* (*). Not uncommon in Tasmanian waters. One was seen by McGarvie in the vicinity of a dead whale at Cape Wickham about 1964 and a beachwashed bird was found on Porky Beach during the

first week of August 1968 (pers. com. Templeton) and Templeton collected another (1970/2/94) on Porky Beach on 17 August 1970.

80. Cape Petrel *Daption capense* (*). Templeton collected two freshly beach-washed specimens (1969/2/56 and 71) on Porky Beach on 8 and 12 July 1969 respectively.

81. Blue Petrel *Halobaena caerulea* (*). Templeton collected a freshly beach-washed specimen (1969/2/112) on Porky Beach on 29 October 1969 and Miss J. Hatten found a desiccated carcase (1970/2/22) on Admiralty Beach on 11 July 1970.

82a. Medium-billed Prion *Pachyptila salvini* (*). Templeton collected seven beachwashed specimens on Porky Beach in 1969 as follows; one (1969/2/36) on 29 June, four (1969/2/52) on 12 July and two (1969/2/74) on 27 July. On 28 July 1970 he collected four (1970/2/48, 49, 51 and 55) from the same area and on 25 July J. Peterson collected one (1970/2/50) one mile inland from City of Melbourne Bay.

83. Fairy Prion *Pachyptila turtur* (*)B. As a result of regular patrols along Porky Beach, Templeton picked up 17 specimens between 29 June and 20 October 1969. All have been registered into the collections of the Queen Victoria Museum for that year. In 1970 from the same area, he collected one (1970/2/8) in March and five (1970/2/44) on 22 July. It breeds in considerable numbers on Albatross Island about 41 miles south south west of King Island (Macdonald and Green 1963).

84. Dove-prion *Pachyptila desolata* (*). Campbell (1888) records a specimen collected by the F.N.C.V. in 1887. Between 27 June and 17 August 1969 Templeton picked up nine beachwashed specimens along Porky Beach. All have been registered into the collections of the Queen Victoria Museum for that year. In 1970, from the same area, he collected one (1970/2/23) on 4 July, one (1970/2/52) on 28 July, one (1970/2/77) on 4 August and one (1970/2/62) on 24 August.

84a. Thin-billed Prion *Pachyptila belcheri* (*). A dead specimen was collected by McGarvie on his farm two miles from sea on 14 August 1959 and sent to the National Museum of Victoria. Templeton collected a desiccated beachwashed specimen (1969/2/4) at Porky Beach on 7 January 1969. From beach patrols in the same area between 22 June and 17 August 1969 he picked up another 12 specimens. All have been registered into the Queen Victoria Museum for that year. In 1970, in the same area, he collected two (1970/2/53 and 54) on 28 July and one (1970/2/64) on 24 August.

85. Diving Petrel *Pelecanoides urinatrix* *B. Common in adjacent waters. There is a small breeding rookery of about 20 burrows on Councillor Island (A.M.McG.). When McGarvie visited the site on 8 July 1966 he found the adults present and apparently engaged in nest cleaning. It also breeds on Black Pyramid about 28 miles south-east of King Island (Green and Macdonald 1964). It is interesting to note that none were found by Templeton on his beach patrols during the winter months in 1969 and 1970.

86. Wandering Albatross *Diomedea exulans* (*). Templeton collected a desiccated beachwashed specimen (1969/2/1) on Unlucky Bay Beach in December 1968. It was an aged bird with white plumage except for some dark markings on the flight feathers and wing coverts. On 12 July 1969 he found the remains of another on Porky Beach, the head of which (1969/2/58) was sent to the Queen Victoria Museum.

88. Black-browed Albatross *Diomedea melanophris* (*). Templeton found a desiccated

specimen on Porky Beach on 4 July 1969 and salvaged the head (1969/2/59).

89. Yellow-nosed Albatross *Diomedea chlororhyncha* (*). Templeton collected the desiccated remains of a beachwashed specimen (1969/2/88) on Porky Beach on 17 August 1969.

90. Grey-headed Albatross *Diomedea chrysostoma* (*). Templeton collected a beachwashed specimen (1969/2/60) on Porky Beach on 12 July 1969 and another (1969/2/81) on Unlucky Bay Beach on 28 July 1969. On 15 July 1970 he found a desiccated specimen on Porky Beach and salvaged the skull (1970/2/21).

91. White-capped Albatross *Diomedea cauta* (*)B. Common in adjacent waters. Dozens of albatross, believed to be this species, could be seen seawards from Martha Lavinia beach on 13 December (R.H.G.). Several hundred pairs breed on Albatross Island, about 41 miles east south-east of King Island (Macdonald and Green 1964) and a small colony was found breeding on Reids Rocks about 10 miles south-east of King Island in 1902 (Campbell 1903). Templeton found a desiccated specimen and salvaged the head (1969/2/85) on Porky Beach on 28 August 1969.

Albatross banded on Albatross Island by Macdonald and Green (1964) have been recovered from Robe and Carpenters Rocks in South Australia, West Rosebud beach in Victoria, 70 miles south of Cape Woolamai, Maatsuyker Island off southern Tasmania, at sea 10 miles west of Albatross Island and at sea 10 miles west of Currie on 5 October 1969. This last bird had been banded on Albatross Island on 17 January 1960 (Macdonald and Green 1964).

Sooty Albatross *Phoebetria* sp. (*). Templeton found the scattered remains of an albatross on Porky Beach on 29 June 1969 but the only parts which warranted salvaging were the head, upper neck and one foot (1969/2/38). This material was not sufficient to determine whether the species was *P. fuscus* or *P. palpebrata*.

96. Black Cormorant *Phalacrocorax carbo* *. A few are seen fairly regularly on lagoons and estuaries, usually as isolated individuals.

97. Little Black Cormorant *Phalacrocorax sulcirostris* *. A few seen fairly regularly.

98. White-breasted Cormorant *Phalacrocorax fuscescens* *B. Common all round the coast and on estuarine waters. A rookery exists on Councillor Island which when visited on 8 July 1966 was found to comprise 75 nests ready for eggs (A.M.McG).

100. Little Pied Cormorant *Phalacrocorax melanoleucus* *B. Common on lagoons and other suitable waters throughout the island, occasionally occurring in small flocks. A rookery comprising about 45 nests and situated about four to five feet above the water in tea-tree *(Meleuca ericifolia)* growing in a small lagoon near Boulder Point has been known to McGarvie for some years. Fairly extensive fires occured in the area in February 1968 and the rookery was deserted in the following breeding season. In 1969 some birds returned to breed at the old site.

104. Australian Gannet *Sula serrator* *B. Common in adjacent waters. Its nearest breeding rookeries are on Black Pyramid, about 28 miles to the south-east of King Island (Green and Macdonald 1964) and Lawrence Rocks about 140 miles to the north-west (McKean 1966).

A gannet banded by Green and Macdonald (1964) on Black Pyramid was recovered at Naracoopa 14 months later. Tasmanian recoveries of Black Pyramid gannets have been made at Lillico Beach, Turners Beach, Devonport, Sulphur Creek, Marrawah and Burnie; in Victoria from Dock Inlet, Lett's Beach, Queenscliffe, Rosebud and in Western Australia from 15 miles south of Mandurah.

112. Caspian Tern *Hydroprogne caspia* *B. Occasionally pairs and individuals are seen round the coast. The F.N.C.V. collected one bird and its nest of three eggs at the mouth of the Sea Elephant River on 8 November 1887 (Campbell 1888).

115. Crested Tern *Sterna bergii* *. Common all round the coast but there are no known local rookeries.

118. Fairy Tern *Sterna nereis* *B. Occurs all round the coast. A few have been known to breed at Lavinia Point and Yellow Rock and in October 1961 about 20 pairs were found breeding at Sea Elephant (A.M.McG).

125. Silver Gull *Larus novaehollandiae* *B. Plentiful all round the coast and considerable numbers come inland to feed on invertebrate animals and to scavenge. A rookery of about 400 pairs on an island in the middle of Currie Harbour is well known. This is recorded by Campbell (1888). Another rookery "on large rocks near Ettrick River," recorded by Campbell (1888), has since been deserted. One bird, banded as a nesting on Sisters Island, north-west Tasmania, on 7 November 1959 was found dead at Currie on 26 November 1962 (R.H.G.).

126. Pacific Gull *Larus pacificus* *B. Common all round the coast and a few pairs breed in the more isolated areas. Campbell (1888) records a "nursery" on the inner of the New Year Islands with most nests containing three eggs. A pair was found resting on the shore of Lake Flannigan in December (R.H.G.) and McGarvie found birds resting beside inland dams during rough weather.

129. Turnstone *Arenaria interpres* *. Small flocks are occasionally seen on rocky tidal reefs. Templeton has seen it at Porky Beach, Currie and Wickham, his earliest record being 30 September in 1970 and his latest on 21 May 1970 when upwards of 50 were seen at Currie.

130. Pied Oyster-catcher *Haematopus ostralegus* *B. Pairs and small parties are common on the coastal beaches where it is a regular breeder. McGarvie observed a pair resting on the edge of a dam about two miles inland during rough weather and occasionally saw it flying across the island.

131. Sooty Oyster-catcher *Haematopus unicolor* *B. Common all round the coast and a regular breeder on the rocky shore in localities where it is undisturbed.

133. Spur-wing Plover *Lobibyx novaehollandiae* *B. Plentiful in the agricultural areas throughout the island. Autumn flocks may exceed 200 individuals (A.M.McG.). McGarvie has found both eggs and young in July.

135. Banded Plover *Zonifer tricolor* *B. A few occurring in pairs and small parties are found throughout the island. McGarvie has found it breeding on the exposed coastal hills near Pass River. It has increased in recent years.

137. Eastern Golden Plover *Pluvialis dominicus* *. A few occur on the tidal reefs and flats at Sea Elephant (A.M.McG.) and Templeton has found it on Porky Beach and near Currie golf links.

138. Hooded Dotterel *Charadrius cucullatus* *B. Common in pairs and small parties on most coastal beaches where it is a regular breeder. Templeton has found wintering flocks of up to 30 individuals.

140. Double-banded Dotterel *Charadrius bicinctus* * . A common visitor from March to late August. Some are usually present on the Currie golf course during the winter months (A.M.McG). They congregate in August, prior to migration and in August 1959 McGarvie found a flock at Egg Lagoon which he estimated at almost 1000 birds. On 6 June 1969 Templeton observed a flock on the aerodrome comprising more than 300 individuals. From May to June, 1970 about 200 lived on a wet flat at Reekara. As late as 23 August up to 20 were still present and were in breeding plumage.

143. Red-capped Dotterel *Charadrius alexandrinus* *B. Common on all coastal beaches where it breeds annually. Templeton found it with newly hatched young at the estuary of Porky Creek on 11 July 1969. It may also occur on inland dams and the edges of exposed or receding lagoons. Green found several on the shore of Lake Flannigan in December. In 1970 early breeding on Porky Beach was disrupted by rough weather during July. The birds moved inland to pasture paddocks where Templeton found them breeding in early August.

144. Black-fronted Dotterell *Charadrius melanops**B. A few occur at various places throughout the island. McGarvie found a nest with eggs in the middle of the road near Cape Wickham lighthouse. Both birds were later killed by cars. He has also found odd nests on shingle beaches on the north coast. Green found a pair at Lake Flannigan on 13 December with a nest containing three eggs, situated about ten yards above the water's edge on dry sunbaked ground. The nest depression was lined with a few broken twigs and small pieces of driftwood. Templeton found six, with other dotterel species, at the estuary of Porky Creek in July 1969.

149. Eastern Curlew *Numenius madagascariensis* *. McGarvie saw one at Cape Wickham on 26 January 1964.

153. Bar-tailed Godwit *Limosa lapponica* *. McGarvie saw two at Duck Bay on 31 October 1961. Templeton saw two on Porky Beach on 17 October 1969. They had disappeared a few days later.

157. Common Sandpiper *Tringa hypoleuca* *. One was seen at the mouth of the Ettrick River on 3 April 1966 (A.M.McG.).

158. Greenshank *Tringa nebularia* *. McGarvie found a pair at Sea Elephant River during the summer of 1964.

161. Curlew Sandpiper *Erolia ferruginea* *. Templeton found seven with a flock of Double-banded Dotterels on a flat at Reekara on 23 August 1970 and ten in the same locality seven days later.

162. Red-necked Stint *Erolia ruficollis* *. Plentiful during the summer at Sea Elephant and Yellow Rock Rivers (A.M.McG.) and at the estuary of Porky Creek (Templeton).

163. Sharp-tailed Sandpiper *Erolia acuminata* *. A few are usually present at Sea Elephant and Yellow Rock River during the summer months (A.M.McG.).

168. Australian Snipe *Gallinago hardwickii* (*). Common throughout the wet marshy areas during the summer months, flocks of up to 100 s metimes being flushed (A.M.McG.). Odd birds were seen regularly along the Pass River in February, usually feeding along the verges of the tail dense tea tree scrub.

179. Australian White Ibis *Threskiornis molucca* *. McGarvie (1965) records a single bird at Grassy in May 1958. In July 1965 he found another at Egg Lagoon.

180. Straw-necked Ibis *Threskiornis spinicollis* *. A few occur occasionally as short term visitors. McGarvie (1965) reports three at Egg Lagoon May 1958 and three in the same area in July 1964. A single bird was present on Tatham's Lagoon during Green's February visit and local residents informed us that it had been there for some weeks previously.

181. Royal Spoonbill *Platalea regia* *. A pair were present on Tathams Lagoon for several months during 1966. They were noticed to fly northwards at dusk but were always on the lagoon at dawn (A.M.McG.).

182. Yellow-billed Spoonbill *Platalea flavipes* *. A single bird was seen at Egg Lagoon on 17 August 1965. It was feeding on the flats which had become flooded after heavy rain and was in the company of Straw-necked Ibis. It had been observed by local residents a few miles northward during the previous two months (McGarvie 1965).

187a. Cattle Egret *Bubulcus ibis* (*). The first record of its occurence on King Island was of a single bird at Egg Lagoon on 17 April 1965 (McGarvie 1965). Other sightings were made later in the same year at Cape Wickham, Yellow Rock and Pegarah and a pair were present at Yambacoona for some weeks during November and early December 1968. (A.M.McG.) In May 1969 McGarvie found two at Pass River and another two at Loorana. P. A. Tatham (pers, com,) reported five living at Pass River in June 1969 and four at Yambacoona in July 1969. In 1970 Templeton found four at Loorana on 20 April. This group had increased to 13 on 26 April and 15 on 27 April. They remained in the area until mid May.

188. White-faced Heron *Notophoyx novaehollandiae* *B. Common round the coast, lagoons and swamplands. It is a regular local breeder. Two flying young were found in the dense tea-tree scrub at Pass River on 24 September (R.H.G.).

192. Nankeen Night Heron *Nycticorax caledonicus* (*)B. The tall dense tea-tree growing along the Pass River supports a fine rookery. When visited on 13 December, breeding had finished and all young had flown. The area was searched and many recently used nests, scattered egg shells (which showed signs of having been successfully incubated) and concentrations of dropping, suggested recent abandonment. When the rookery was revisited at the end of the following September, breeding was found to be at a peak with about 100 nests occupied and concentrated mostly in an area of about 300 yards by 50 yards. They ranged in height from 15 to 40 feet and were usually placed in the upper branches of the tea trees. Some were robust and appeared to have been relined and reused for many years. Material used was almost solely small sticks placed with the larger end inwards and radiating from the centre of the nest, giving the impression of a heavily spoked and concaved wheel. The nests contents ranged from fresh eggs to almost fully fledged birds and several young were found which had abandoned their nests. Of the dozen or so nests examined, three was the maximum complement with the nestlings of any one nest varying considerably in size. This is apparently due to a time lapse of several days between the laying of each egg with incubation commencing following the laying of the first egg. This would allow easier feeding of the young when food is scarce, since the maximum demand at any time will be reduced by this staggering of hatching. It also means that parents can at least ensure the older, bigger chicks survive when they cannot feed the entire brood. This has been noted to occur in the Swamp Harrier (Green 1965).

The stomachs of the nestlings were considerably distended and, as a food source was not obvious, the largest member of a clutch of three (unfeathered) was dissected and found to contain beetle remains, a cockroach and three complete house mice (1968/2/231).

Between sunset and dusk on the evening of 27 September, 26 Night Herons were seen to fly from the rookery as if moving out to feed. Dispersal was in all directions but principally inland, the birds flying at considerable height, singly or in small parties.

The rookery has been known to the local farmers for upwards of 30 years but an almost complete lack of summer and autumn sightings indicated that the birds move to the Australian mainland following breeding. It is very rarely seen in Tasmania.

During Green's visit in December 1968 only seven Night Herons were found. A juvenile was flushed several times from a small, tea-tree lined pond at Pass River and a party of six adults was flushed from a diurnal roost in tall tea-tree at Lake Flannigan on 13 December. No birds could be found during the February visit. On 26 May 1969 P.A. Tatham (pers. com.) sighted nine Night Herons flying over Pass River. At midday on 1 July 1969 he visited the rookery and counted about thirty birds which he managed to flush from the nesting area. Templeton (pers. com.) inspected the rookery on 21 August 1969 and found nest construction and renovation had commenced but no eggs were found. He visited it again on 10 September 1969 and found breeding had commenced. Some nests appeared to be still under construction but others contained eggs in various stages of incubation. No nestlings were found and he estimated about 250 Night Herons were present. He again inspected the rookery on 17 October 1969 when the nests were found to contain eggs and young in various stages of development. From these observations it appears that birds begin arriving at the rookery during May and egg laying commences about July. This may be extended over the following two months but by the end of December, the rookery is again deserted and most birds have left the island.

197. Brown Bittern *Botaurus poiciloptilus* *. This bird is rarely seen today but odd individuals are sometimes heard calling from the swamps. In earlier years it was quite common (pers. com. B. C. Heddle).

198. Cape Barren Goose *Cereopsis novaehollandiae*. The first known occurrence was on 28 July 1969 when four were found feeding on pasture in the Reekara district. It is believed they were part of a small consignment which had been taken from the Furneaux Islands and liberated on Hunter Island, north-west Tasmania, the previous year.

203. Black Swan *Cygnus atratus* *B. Common on most lagoons and estuaries and a regular local breeder. Many were found with half-grown young in December and most of those on Tatham's Lagoon were still present in February, despite the low water level and the apparent ability of most of the young to fly. Small to half-grown cygnets were present on Tatham's Lagoon in September.

207. Mountain Duck *Tadorna tadornoides* *. Rarely encountered on the island. McGarvie recalls seeing this species on only two occasions, three flying over Egg Lagoon in 1960 and three at Tatham's Lagoon in 1962.

208. Black Duck *Anas superciliosa* *B. Common on lagoons and estuaries throughout the island and a regular local breeder. A few were present on most lagoons in December and the following September pairs, often with young, were a common sight on lagoons and farm dams. On 29 September one was found swimming with three domesticated Mallards at the Pegarah forestry reserve.

210. Chestnut Teal *Anas castanea* *B. Common on lagoon and farm dams throughout the island and a regular local breeder. Many such sites supported pairs with clutches of young in September.

211. Grey Teal *Anas gibberifrons* *. A few are seen occasionally on the lagoons but the island does not appear to be greatly favoured. There are no local breeding records.

212. Blue-winged Shoveler *Anas rhynchotis* *B. A few are seen fairly regularly on the lagoons and farm dams. Four were on Bowling's Lagoon in December. It breeds annually in the long grass on the flats at Egg Lagoon (A.M.McG.).

215. Hardhead *Aythya australis* *B. A few occur at irregular intervals (A.M.McG.).

216. Blue-billed Duck *Oxyura australis* *B. Occasionally occurs in pairs on the lagoons. In December two were present on Pearshape Lagoon and at least one on Bowling's Lagoon. McGarvie found a pair with four young on Pearshape Lagoon in October 1961.

217. Musk Duck *Biziura lobata* *. A few are usually present on most larger lagoons. In December they were present on Bowling's Lagoon, Pearshape Lagoon, Lake Flannigan, Penny Lagoon and Tatham's Lagoon. There are no local breeding records but a male, accompanied by two females, was engaging in courtship display in a lagoon near Boulder Point on 26 December (R.H.G.).

219. Swamp Harrier *Circus approximans* *B. Common during the summer months with some birds remaining over winter. It was regularly seen during Green's visits in December, February and September. It is a constant predator upon young pheasants, a habit which incites some local residents to destroy it at every opportunity.

220. White Goshawk *Accipiter novaehollandiae*. There are no reports of this bird occurring on the island in recent years. Campbell (1888) includes it in a list of King Island birds following the visit of the F.N.C.V. in 1887. Heddle recalls having shot two which were killing young turkeys at Loorana about 1912.

224. Wedge-tailed Eagle *Aquila audax* *. A rare visitor to the island. McGarvie saw one in May 1959, P. A. Tatham saw one near Pass River in 1966, Templeton saw one at Reekara on 23 March 1969, one at Currie on 14 April and 23 May 1970, and one at Loorana on 18 May 1970. Campbell (1888) also includes it in his bird list.

226. White-breasted Sea Eagle *Haliaeetus leucogaster* *B. Frequently seen round the coast and all over the island. In December a pair were seen to rise from a small lagoon at Yellow Rock and a pair were roused from the edge of an access road in the forestry reserve at Pegarah. A nesting site is known at Boulder Point (A.M.McG.) and a nest, situated high up in a large eucalypt growing in a steep gorge in the Pegarah forestry reserve, was found occupied in 1967 and 1968 seasons (R.H.G.).

228. Whistling Eagle *Haliastur sphenurus* *. McGarvie (1965) observed one at Egg Lagoon in May 1965. It was often seen to feed on wallaby carcases and remained in the vicinity for several weeks. Templeton saw one at Yambacoona on 15 September 1967, one on the east coast flying northwards on 23 July 1969 and one flying northwards over Loorana on 18 September 1970.

237. Peregrine Falcon *Falco peregrinus* *. A rare visitor. McGarvie saw one at Egg Lagoon on 2 September 1963 and noticed that it had terrified ducks in the vicinity.

239. Brown Hawk *Falco berigora* *B. Common throughout the island and a regular local breeder. A nest containing two well fledged young was found situated about 20 feet up in the thick canopy of a clump of tea trees near Lake Flannigan on 12 December. A pair, presumably the parent birds, was regularly seen resting on a nearby stack of baled hay.

In January 1966 McGarvie counted 27 on the ground near Cape Wickham, apparently feeding on field crickets. Similar behaviour was observed by Green (1969) on Flinders Island in March 1966.

240. Nankeen Kestrel *Falco cenchroides* *. A few are present all the year round (A.M.McG.). Three were seen feeding on the ground in an open paddock near Pegarah on 13 December and two in the same area on 26 September (R.H.G.).

245. Spotted Owl *Ninox novaehollandiae* *B. A few occur all over the island. The gradual reduction of the tall decaying eucalypt stumps is continually reducing the available natural nesting sites and probably is responsible for a decrease in the owl population. Two instances are known where this species has resorted to artificial sites. In 1966 P. A. Tatham found a nest containing two fertile eggs tended by a sitting bird in a space between baled hay and the barn wall. Unfortunately the eggs were broken by dogs but the bird continued to occupy a diurnal roost beneath the roof of the barn for some months afterwards. In 1967 Mr. Lindsay Poke of Egg Lagoon found a spotted owl nesting in a wooden box (about 24 x 18 x 10 inches) which had, some time previously, been placed beneath a tank stand at a height of about twelve feet for the use of a pet possum. Two eggs were laid but only one hatched. When examined on 15 December it was found to be about three-quarters grown. The remains of house sparrows were scattered beneath the nest.

249. Barn Owl *Tyto alba* *. One flew over Egg Lagoon at dusk one evening in January 1959 (A.M.McG.). Templeton also saw one at Loorana in 1968.

254. Rainbow Lorikeet *Trichoglossus moluccanus* *. One bird was seen by McGarvie at Egg Lagoon on 23 June 1966 and subsequently was seen and heard flying overhead several times each day for the following week (Thomas 1968).

258. Musk-lorikeet *Glossopsitta concinna* *. About 1950 McGarvie saw ten flying in a south-easterly direction over Egg Lagoon. On 21 April 1966 the same observer saw three flying northwards over north King Island (Thomas 1968).

264. Red-tailed Black Cockatoo *Calyptorhynchus banksia*. This species, or possibly the Glossy Black Cockatoo, once occurred on the island but disappeared about 1920 following extensive fires (pers, com. B. C. Heddle). It has not been recorded since.

267. Yellow-tailed Black Cockatoo *Calyptorhynchus funereus* *B. Common at times but particularly during the autumn months (A.M.McG.). McGarvie has seen a flock of 106 at Egg Lagoon. Near the forestry reserve at Pegarah in December, one was watched to fly to a hole about 100 feet up in the exposed face of a tall decaying eucalypt stump. It clung there for some time and appeared to be feeding young. The perimeter of the entrance was heavily scarred.

268. Gang-gang Cockatoo *Callocephalon fimbriatum*. Once plentiful when the big eucalypt forests existed (pers. com. B. C. Heddle) but now very rarely seen.

A skin was obtained by Péron in 1802 (Stresemann 1951) and another on the visit of the F.N.C.V. in 1887 (Campbell 1888).

269. White Cockatoo *Kakatoe galerita* *. Once present when the eucalypt forests existed but died out or left the island about 1920 following extensive bush fires (pers. com. B. C. Heddle). Up to five were living in the Reekara district during most of 1968 but, by their willingness to feed in a farmyard with domestic fowls, they appeared to be escaped aviary birds.

273. Galah *Kakatoe roseicapilla* *. A rare visitor. Odd birds or small flocks occur at irregular intervals. In March 1967 a flock of about 30 was seen near Surprise Bay.

285. Green Rosella *Platycercus caledonicus* (*)B. Common in a few scattered localities. The species was once much more plentiful than it is today. (pers. com. B. C. Heddle) The reduction of the eucalypt forests has greatly restricted its favoured habitat and the acarcity of suitable nesting sites must also be inhibiting breeding. The species is common in the forestry reserve at Pegarah where in February a number of young birds were seen soliciting food.

305. Orange-breasted Parrot *Neophema chrysogaster* *. Small parties appear on the island about March, usually disappearing about July. In 1959 a flock of up to 75 was present in the paddocks at Egg Lagoon and in October 1961 six were seen at Sea Elephant. In most years flocks number about 20 to 30 (A.M.McG.). McGarvie also observed that they were usually on the wing before daylight and did not settle until after dark. They often feed among the dandelions and rushes. (see also Jarman 1965)

306. Blue-winged Parrot *Neophema chrysostoma* *. A few are usually present in widely scattered areas during the spring and summer and some occasionally remain over winter (A.M.McG.). The F.N.C.V. found it in 1887 (Campbell 1888). McGarvie observed northward migration on 13 April 1966 (Thomas 1968).

309. Swift Parrot *Lathamus discolor* *. Flocks of 20 to 30 are seen and heard flying southwards in September and returning northwards in March. It has not been found to settle on the island.

326. Sacred Kingfisher *Haylcon sanctus* *. Odd pairs and individuals are occasionally seen, particularly in southern parts of the island. The F.N.C.V. collected a specimen in 1887 (Campbell 1888).

334. Spine-tailed Swift *Hirundapus caudacutus* *. Passing migrants are seen every year from January to April (A.M.McG.). Numbers were seen frequently passing northwards over the Pegarah area in February. McGarvie has seen it attracted to feed on flying insects which were disturbed by a tractor working among the rushes at Egg Lagoon.

335. Fork-tailed Swift *Apus pacificus* *. Between 11.30 a.m. and 1 p.m. on 7 February 1967 a flock of at least 500 were seen to pass from east to west over Egg Lagoon. No spine-tailed swifts could be seen among them (A.M.McG.). About 30 to 40 were seen in 1961 (A.M.McG.).

337. Pallid Cuckoo *Cuculus pallidus* *B. A few are present during the spring and summer and flying young were seen in February. McGarvie found birds on 25 September 1966 (Thomas 1968) and Green found it on the same date in 1968. Templeton found two near Pass River on 30 August 1968.

338. Fantail Cuckoo *Cacomantis pyrrhophanus* (*) B. A few occur in the spring and summer and odd birds remain over winter (A.M.McG,). It was regularly seen at the forestry reserve in Februarv but none were found during Green's September visit.

342. Horsfield Bronze-cuckoo *Chalcites basalis* *B. A few occur in the spring and summer and a number were seen and heard from 26 September.

344. Golden Bronze-cuckoo *Chalcites plagosus* *B. A few occur in the spring and summer and it was heard and seen in several localities from 26 September.

357. Welcome Swallow *Hirundo neoxena* (*)B. Plentiful in the spring and summer. Most migrate in the autumn though a few always remain over winter (A.M.McG.). Templeton found about 30 remained near Porky Creek over the winter of 1969. It was still plentiful at the end of February and was often seen in small flocks. Manv old nests were found beneath bridges, verandahs, eaves, in sheds and disused houses. Nests with eggs and newly hatched young were found at Pass River on 23 September.

359. Australian Tree-martin *Hylochelidon nigricans* *. A few are present in the spring and summer but all migrate in the autumn (A.M.McG.). There are no local breeding records.

361. Grey Fantail *Rhipidura fuliginosa* (*)B. Common throughout the year but especially in the spring and summer. It was commonly observed by Green on all visits.

364. Willie Wagtail *Rhipidura leucophrys* *. A rare visitor, odd birds occurring for short periods and at irregular intervals. A pair lived at Egg Lagoon from March to May 1968 (A.M.McG.).

366. Satin Flycatcher *Myiagra cyanoleuca* (*). Common in a few areas during the summer. It was regularly seen in the Pegarah forestry reserve in February, usually high up in the eucalypts or on the perimeter of the pine plantation. Early one morning a single bird was attracted by a fly on the inside of a window of the camp and was observed to make several attempts to take it through the glass despite the close presence of the observer.

382. Flame Robin *Petroica phoenicea* (*)B. Common throughout the island and regularly seen by Green on all visits, particularly in the Pegarah forestry reserve.

383. Pink Robin *Petroica rodinogaster* *. Rare, a few occurring in the dense gullies. McGarvie has seen odd birds at the Nook and in his garden at Egg Lagoon during the winter months.

386. Dusky Robin *Amaurodryas vittata* (*)B. Plentiful and widespread over the island and occurring in a wide range of habitat. Nests with eggs and half grown young were found in September.

398. Golden Whistler *Pachycephala pectoralis* (*)B. A few throughout the island but mostly confined to the eucalypts and tall tea trees.

401. Rufous Whistler *Pachycephala rufiventris* *. McGarvie observed a male in mature plumage in his garden at Egg Lagoon on 28 October 1968 and in the following two weeks made three sightings of females in the scrub country between Egg Lagoon and the east coast. Templeton found a male at Reekara on 7 September 1969.

405. Olive Whistler *Pachycephala olivacea* (*)B. Common and widespread particularly in the eucalypt and tea tree scrub.

408. Grey Shrike-thrush *Colluricincla harmonica* (*)B. Common and wisespread particularly in the eucalypt and tea tree scrub. At the Pegarah forestry reserve a subadult regularly visited the windows of our camp to attack its reflection.

415. Magpie Lark *Grallina cyanoleuca* *. One was seen at Pass River on 29 April 1965 and in the same locality on several occasions during the following winter (A. M.McG.). Mr. Len Sullivan had six living on his property at Pearshape during 1970 and suggests that some may have bred in the area about 1960.

424. Black-faced Cuckoo-shrike *Coracina novaehollandiae* (*). A few are regularly seen each summer but there are no records of it having bred on the island. Several were seen at the forestry reserve in February. On the morning of 1 May 1965 McGarvie saw a flock of 25 flying seaward (north) from Cape Wickham and on 21 April 1966 he observed fifteen passing northwards over Egg Lagoon.

430. White-winged Triller *Lalage sueurii* (*). Templeton found an adult female at Loorana on 11 October 1968 and McGarvie found an adult male near Boulder Point on 30 November 1968. Templeton saw individuals at Loorana on 25 February and 19 March 1969.

447. Australian Ground-thrush *Oreocincla lunulata* (*)B. Common in the tea tree scrubs and dense gullies all over the island. Because of its habit of scratching among the litter for its food, it sometimes becomes a nuisance in the country gardens which it invades from nearby stands of dense tea tree. Young birds newly out of the nest were seen at Egg Lagoon on 25 September.

448. White-fronted Chat *Epthianura albifrons* *B. Common in the open grassland and round the swamps and lagoon edges.

473. Tasmanian Thornbill *Acanthiza ewingii* (*)B. Plentiful all over the island and occurring in all habitat types. It is one of the most commonly encountered birds. Many thornbills were handled at Pass River and Pegarah forestry reserve in February and all except one (see 475) proved to be of this species. Its prolific numbers and general distribution are consistent with that found on Flinders Island (Green 1969). In Tasmania its distribution is restricted to the rainforests, and its place being taken in the drier habitat by *A. pusilla*. Campbell (1888) does not include it in the list of species encountered by the F.N.C.V. in 1887. This is most surprising in view of their extensive collecting and its present population. Campbell (1903) and Campbell (1903*a*) give the first references to this species on King Island when they mention a single specimen, collected in November 1902 which they believed to be "a re-discovery of Gould's long-lost *Acanthiza ewingii*."

Mack (1936) found it common "on a recent visit." Mayr and Serventy (1938) refer to a series of King Island birds which they state "fall within the same range variation, (as the Tasmanian race) although the averages are smaller." Measurements taken by Green on a recently collected series are presented in the accompanying table and agree with the conclusions of Mayr and Serventy (1938) except for the culman which is slightly larger in the King Island race. The males of both races are somewhat larger than the females from the same area.

The species appears to have been rare on King Island at the beginning of the twentieth century and to have increased greatly in the last 60 years.

		TAIL	WING	TARSUS	CULMAN
King	9 female	43-49(46.4)	49-54(51.0)	20.5-21.8(20.9)	11.6-13.3(12.3)
Island	10 male	46-52(47.5)	50-53(51.8)	20.5-22.5(21.2)	12.5-13.2(12.9)
Northern	7 female	47-51(49.0)	50-52(50.4)	20.4-21.6(21.2)	11.0-11.9(11.6)
Tasmania	10 male	50-54(51.6)	51-56(53.4)	21.0-22.6(21.8)	11.8-12.9(12.3)

475. Brown Thornbill *Acanthiza pusilla* (*)B. A subadult male, with the skull only slightly ossified (1968/2/163) was collected by Green in the Pegarah forestry reserve on 28 February. This is apparently the first specimen collected on King Island since A. G. Campbell secured four on 10 November 1902 which A. J. Campbell (1903*a*) described as a new species *A. magnirostris*, the Large-billed Tit, and later (Mathews 1910) renamed *A. archibaldi* . Mack (1936) includes it as a subspecies of *A. pusilla*. Mayr and Serventy (1938) doubt its validity as a subspecies. Campbell (1888) indicates that skins and eggs of *A. diemenensis* (= *A. pusilla*) were collected during the F.N.C.V. expedition to the island in 1887 but the authors have been unable to examine these specimens or to verify that they were in fact of this species and not *A. ewingii* .

Green has seen two of A. G. Campbell's specimens, now held in the H. L. White collection, National Museum of Victoria (reg. nos 2087 and 2088) and found that they agree with the recently collected bird, the measurements of which are as follows: weight 7.7 gm., total length 117, tail 40, wing 52, wing spread 161, tarsus 20, middle toe 12.3, culmen (measured to skull on dried specimen) 16.2. Mack (1936) gives measurements of three specimens and states "During a recent visit to King Island no specimen of this form was seen although I made an intensive search. On the other hand *Acanthiza ewingii* was fairly numerous." In February and September, Green personally handled several dozens *Acanthiza*, from the locality in which the single *A. pusilla* was taken, as well as numerous birds from Pass River and other areas but no further specimens of *A. pusilla* could be found. The specimen collected at Pegarah was netted in dense mixed dry scrub and in association with a high population of *A. ewingii*. It was immediately recognised by its conspicuously greater bill length (16.2 compared with 11.6 to 13.3 (mean 12.6) for *A. ewingii* from the same area.) Mayr and Serventy (1938) give culmen lengths (measured from skull) for five Tasmanian *A. pusilla* as ranging from 14 to 14.5 (mean 14.1). A series (of 16, equal sexes) from northern Tasmania, held in Green's personal collection and measured by him in the same manner as the 1968 King Island bird, range from 12.4 to 14.1 (mean 13.3). The rarity of *A. pusilla* on King Island compared to the present high population of *A. ewingii* suggests that the latter may be surplanting the former but the reasons for this are obscure. It is surprising to find *A. ewingii*, the rainforest species of Tasmania, so strongly established in the dry sclerophyll and heathland and apparent failure of *A. pusilla* to populate and compete successfully in this habitat which is normally it's stronghold. Whatever the reasons, they may have been likewise responsible for the present situation on Flinders Island where only *A. ewingii* occurs today.

487. Scrub-tit *Acanthornis magnus* (*)B. A few occur in the damp fern gullies but its secretive habits make it difficult to detect. Its presence on the island was not suspected until 1966 when Courtney and McGarvie found it at Pass River, previous to which it had not been recorded beyond

the Tasmanian mainland. Several were seen by Green at Pass River and McGarvie has seen it at Pegarah forestry reserve, The Nook and Yellow Rock.

495. Brown Scrub-wren *Sericornis humilis* (*)B. Plentiful throughout the island and occurring in a wide range of habitat. It is one of the most commonly encountered species. The average body weight (18.2), total length (134.4), wing span (185.8) is similar to that of the Tasmanian race (Green 1969).

522. Little Grassbird *Megalurus gramineus* *B. Several were heard calling from rushes growing in a swampy area near Grassy in July 1966 (A.M.McG.). Campbell (1903) also listed it as "whistling among the reed-beds bordering lagoons." Templeton has often seen it amongst the tall grass on swampy ground beside Porky Creek where he found a nest with three well developed young on 27 October 1970.

525. Golden-headed Fantail warbler *Cisticola exilis* (*)B. Common in the tall grass and rushes. With the drainage and conversion to improved pastures of much of its natural habitat it has readily adapted to living among the introduced "tall fescue" which today grows prolifically in many of the low lying wetter areas. This grass grows to a height of several feet in the spring and provides excellent shelter and nesting sites. Many nests and young birds are destroyed annually by tractor driven slashers which are used to remove the rank growth. The F.N.C.V. collected it at Egg Lagoon in 1897. This area has since been drained for pastoral development but *C. exilis* is still common here, along the water courses and such places where the vegetation is tall and rank.

529. Superb Blue Wren *Malurus cyaneus* (*)B. Plentiful all over the island. A. G. Campbell (1903) found it to be "one of the commonest birds on the island". He gives details of its characteristics and includes a coloured plate to illustrate the darker plumage which gave rise to it being described by A. J. Campbell (1901) as a distinct species *M. elizabethi*, the Dark Blue Wren. Mathews (1923) considered it merely a subspecies.

543. White-breasted Wood-swallow *Artamus leucorhynchus* *. McGarvie (1965) found four at Egg Lagoon on 15 June 1961. They remained for three days. One was collected and lodged in the National Museum of Victoria.

544. Masked Wood-swallow *Artamus personatus* *. McGarvie (1965) found two at Egg Lagoon on 26 November 1963. They were in company with eight White-browed Wood-swallows. Nine were seen on 2 February 1964, three of which were in juvenile plumage. They were last seen on 9 February 1964. On 15 July 1970 Lance McGarvie found an adult (1970/2/56) apparently exhausted and near to death at Egg Lagoon. Very rough weather was prevailing at the time. There are no records from Tasmania.

545. White-browed Wood-swallow *Artamus superciliosus* *. McGarvie (1965) has found it to be a fairly regular visitor, usually arriving in the north of the island about November each year and departing about March but has records of odd birds for every month of the year. There are no local breeding records. Sharland (1958) records that many appeared on King Island on 9 April 1905. There are no records of this species from Tasmania.

547. Dusky Wood-swallow *Artamus cyanopterus* *. A few during the summer months (A.M.McG.). This species was collected by the F.N.C.V. in November 1887 (Campbell 1888) and a few pairs were seen in the eucalypts by Campbell in November 1902. None could be found by Green in December or February, months when the species is normally plentiful and conspicuous in Tasmania. Templeton observed 19 at Yambacoona in July 1970. Its occurrence on Flinders Island as a transitory species only (Green 1969) and the lack of breeding records on King Island suggests that its presence here is

primarily as a transitory migrant.

565. Spotted Pardalote *Pardalotus punctatus* *B. A few occasionally seen (A.M.McG.). Green was unable to locate it. Ian Abbott (pers. com.) found a breeding pair in October 1970.

567. Striated Pardalote *Pardalotus striatus* *. A few occasionally seen (A.M.McG.). Green was unable to locate this species. It was collected by the F.N.C.V. in 1887 (Campbell 1888) and Campbell (1903) found it common where gum trees existed. Its numbers have apparently been reduced with the habitat alteration.

571. Forty-spotted Pardalote *Pardalotus quadragintus*. Campbell (1888) records that it was collected by the F.N.C.V. a few miles north of Currie in 1887. There are no other records.

574. Grey-breasted Silvereye *Zosterops lateralis* (*)B. Plentiful throughout the island during the autumn months especially. In December it was regularly found in all habitat types and often seen to feed among the eucalypt foliage in the same manner as the thornbills. McGarvie saw an all yellow bird in 1963 and again in 1967. Templeton saw two lemon coloured individuals at Loorana in May and June 1969.

582. Strong-billed Honeyeater *Melithreptus validirostris* (*)B. Common where eucalypts occur and occasionally seen in the tall tea trees. It was found with flying young among the tall dense tea tree along the Pass River on 13 December. In February parties of about a dozen, including birds in adult and subadult plumage, were regularly seen in the Pegarah forestry reserve. Its favoured feeding places are the trunks and boughs of the eucalypts and on the tea trees where the loose paper bark provides a cover for a good source of insect food. It was usually found in parties and showed little concern at our presence. When feeding on the trunks of the tea trees it would often descend to ground level and search among the litter as close as ten feet from the observer. This behaviour has not been recorded from the Tasmanian population.

584. Black-headed Honeyeater *Melithreptus affinis* (*)B. Now rare on the island. Campbell (1888) records it being collected in the Fraser River area. Campbell (1903) refers to it as being plentiful along the Pass River but in three visits Green has been able to find only one bird in this area. This was on 22 December when it was found feeding in the foliage of one of the few remaining eucalypts growing among the tall tea tree. Campbell (1903), referring to Pass River, states that "From a bird's point of view, it is like an oasis in a desert of pasture." The introduced pastures now extend almost to the banks of the stream and in most places the width of the native bush is little wider than a "stones throw."

McGarvie saw a pair at Egg Lagoon on 11 May 1966 and a few on odd subsequent occasions. Small parties were found feeding in the upper foliage of eucalypts in the Pegarah forestry reserve during the first week in October.

591. Eastern Spinebill *Acanthorhynchus tenuirostris* . Now either very rare, or no longer exists, on the island. The F.N.C.V. collected it in 1887 at Porky Lagoon and near the Fraser River. (Campbell 1888) and Campbell (1903) record it as occurring about the homestead gardens and in the native bush. The present authors have never seen it on the island. Heddle told us of a bird, the description of which fitted this species, which is occasionally seen feeding on fuschias in his garden at Currie. Salomonsen (1966) has described the King Island population as a subspecies, *A.t.regius* from a subadult male (reg. no. 693497) in the collection of the American

Museum of Natural History.

593. Tawny-crowned Honeyeater *Gliciphila melanops* *. A few occur in the heathy areas near Lake Martha Lavinia (A.M.McG.).

614. Yellow-faced Honeyeater *Meliphaga chrysops* *. McGarvie has observed this bird in the heath and stunted eucalypts near Boulder Point for some years, and several dozen were present in September. It appears to be increasing.

616. Yellow-throated Honeyeater *Meliphaga flavicollis* (*)B. Common throughout the island and a regular local breeder. A nest with three halfgrown young was found, at the Pegarah forestry reserve in December, situated about nine feet up in thick scrub.

630. Crescent Honeyeater *Phylidonyris pyrrhoptera* (*)B. Common throughout the island, especially so in the mixed scrubs within the boundary of the Pegarah forestry reserve. It was often found feeding in the flowering honeysuckles *Banksia marginata* and young birds which had just left the nest were found at Pegarah on 27 February.

631. Yellow-winged Honeyeater *Phylidonyris novaehollandiae* (*)B. Plentiful throughout the island and the most common honeyeater. Subadults which had apparently left the nest no more than two weeks previously were found at Pegarah forestry reserve on 28th February. A nest with eggs was found at Pass River on 25 September. Salomonsen (1966) places this honeyeater in the genus *Phylidonyris* and at the same time describes the Bass Strait population as subspecifically distinct under the name *P. n. caudata* . A sample collected by Green in February was found (as stated by Salomonsen 1966) to be larger than Tasmanian birds. This is illustrated in the accompanying table. The measurements are from adults only.

	TASMANIA		KING ISLAND	
	18 Males	6 Females	11 Males	2 Females
Weight (gm)	22.0	20.1	22.7	19.2
Total length	185	174	198	181
Tail	80	75	88	78
Wing	79	75	82	75
Wing Span	237	222	243	221
Tarsus	22.9	22.4	23.8	22.4
Toe	14.8	14.5	15.0	13.7
Bill	23.7	22.2	27.1	24.3

Comparative proportions of *P. novaehollandiae* from Tasmania and King Island.

639. Yellow Wattlebird *Anthochaera paradoxa* (*)B. A few throughout the island but principally in the areas of eucalypts. A small party was seen at Pass River in February where they regularly visit the farm gardens to feed among the introduced flowering shrubs.

647. Australian Pipit *Anthus australis* (*)B. A few, principally in the areas of unimproved grassland and natural clearings. Campbell (1903) found it common but this is scarcely the case today. The introduced skylark is

now plentiful on the introduced pastures and the expansion of this man-made habitat at the expense of the native grassland may have been responsible for a decrease in the status of the pipit. Several pairs were found along the access roads of the Pegarah forestry reserve on 29 September and at least one was carrying nesting material.

690. Little Raven *Corvus mellori* (*). Occurs all over the island but fluctuates numerically. Heddle states "when commercial game snaring was being carried on about 40 years ago the raven was quite plentiful and used to follow the snare lines to feed on the discarded wallaby carcases. With the decrease in the price of furs and subsequent lack of snaring the raven became less common." It now appears to be increasing again, probably due to the increase in agriculture which is providing it with an enhanced food supply in the form of pasture parasites and farm refuse. Only one bird was found by Green in the three visits and it seems apparent that the species is nomadic and its occurrence is probably influenced by food supply. Locally abundant populations occur round lambing paddocks in the winter months and are sometimes trapped by farmers. A sample was thus collected by Mr. A. McSweyn in June 1970 enabling positive determination (Rowley 1970).

696. Black Currawong *Strepera fuliginosa* (*)B. Common in parts. Several dozen were seen at Boulder point in December and a few pairs and individuals were present at Pass River and Pegarah in February. McGarvie has seen flocks of from 30 to 40 apparently feeding on maggots in the decaying kelp at Surprise Bay. Campbell (1888) records similar behaviour on the coast at Whistler Point and found it one of the most plentiful birds. During the winter months flocks of up to 150 have been seen feeding on pasture parasites.

707. White-backed Magpie *Gymnorhina hypoleuca* *B. Introduced from Victoria about 1901 it has since spread over the island and today is one of the most common and conspicuous birds. In the agricultural areas it is usual to see dozens within an area of perhaps 100 acres. The present lack of eucalypts does not appear to have impeded its well-being as it makes good use of tall tea trees and introduced pine plantations as shelter and nesting sites. Breeding was well advanced in September, both flying young and nests with eggs being found.

INTRODUCED FOREIGN SPECIES

991. Blackbird *Turdus merula* (*)B. Common all over the island especially along the dense tea tree creeks and in the tea tree shelter belts where it finds good cover and nesting sites.

993. Skylark *Alauda arvensis* *B. Plentiful in all the pastoral areas and greatly increased in numbers in recent years.

995. House sparrow *Passer domesticus* *B. Common all over the island, but principally in the vicinity of farms and towns.

996. Goldfinch *Carduelis carduelis* *B. Plentiful all over the island.

997. Greenfinch *Chloris chloris* *B. Common and regularly seen and heard in the vicinity of the tall tea tree scrubs where it finds good shelter and nesting sites.

999. Common Starling *Sturnus vulgaris* *B. Very common all over the island, especially in the agricultural areas.

Pheasant *Phasianus colchicus* var. *B. Common all over the island and often

seen in the pastoral areas in the vicinity of hedges and dense tea tree shelter. It was first introduced about 1912 when eggs were brought in and hatched under a bantam and the young birds liberated (pers. com. B. C. Heddle). A note on the introduction of the pheasant and other birds to King Island appeared on Page 11 of the King Island News of 6 May 1970 under the heading "How the Pheasant came to King Island."

Californian Quail *Lophortyx californicus* (*)B. Common all over the island but preferring to remain in or near to the shelter of the dense tea tree or scrubland where it can find good shelter and breeding sites. It was first introduced to the island from New Zealand about 1920 and was originally liberated and became established near Currie (pers. com. B. C. Heddle).

Peafowl *Parvo cristatus* *B. A small feral population has been living in the Pass River - Reekara area for many years. The number is kept low because they are occasionally shot for the dining table.

OTHER LAND VERTEBRATES

MAMMALS

Campbell (1888) gives a list of the mammals encountered during the Field Naturalist Clubs of Victoria expedition in 1887. One species has since died out.

Spiny Ant-eater *Tachyglossus setosus* . A few occur throughout the island. One (1968/1/12) was collected near Pegarah. Campbell (1888) described it as being plentiful and collected several.

Platypus *Ornithorhyncus anatinus*. Campbell (1888) records seeing only one. A few are known to occur in the rivers, creeks and lagoons, mostly on the eastern side of the island.

Red-necked Wallaby *Wallabia rufogrisea*. Plentiful throughout the scrubland from which it invades the pastoral areas at night to graze. It was commonly seen grazing along the edges of the access roads in the Pegarah forestry reserve and a specimen (1968/1/15) was collected. One skull (1967/1/62) was obtained from Pass River on 14 December and three more (1967/1/60) from the same area on 15 December.

Pademelon *Thylogale billardieri*. Plentiful wherever the thick tea tree scrub occurs. It invades the pastoral areas at night as does the preceding species.

Potoroo *Potorous tridactylus*. A few still remain in the thick tea tree scrub but the clearing of these areas for pastoral development is reducing drastically its already limited habitats. It is smaller in size and much browner in pelage than the Tasmanian form, features which prompted Courtney (1963*a*) to describe it as subspecifically distinct under the name *P. t. benormi* . Minor corrections were given later by Courtney (1963*b*). The types were lodged in the Australian Museum (Courtney 1963*b*). The Queen Victoria Museum holds two spirit specimens (1964/1/9, 1968/1/37) and one skin with skull (1946/1/3). A female has been kept in captivity by Green for the past three years and has to date reared one young after mating with a male from Tasmania. This offspring was a female which, in the following year was found to be carrying a pouched young.

Wombat *Vombatus ursinus*. The log books of the "Lady Nelson" record the occurrence of wombats on King Island in January 1802 (Lee 1915, Alexander 1921).

Péron (1804) included a plate (no. 28) following his visit in December 1802.

The F.N.C.V. were unable to find wombats during their visit in 1887 and the animal appears to have died out sometime prior to the beginning of the twentieth century. Spencer and Kershaw (1910*a* and *b*) give some details of its discovery and relationship.

Brush-tail Possum *Trichosurus vulpecula*. Plentiful in the tea tree scrubs and eucalypt country. The scarcity of tree hollows, rock crevices and other diurnal retreats results in it using such sites as hay stacks and platforms of accumulated sticks and litter in the upper foliage of tea trees and introduced pine plantations. Green found one occupying an old night heron's nest at Pass River in February and Templeton has made similar observations.

Only the grey phase, similar to that of Flinders Island and the Tasmanian midlands and north east, occurs on King Island. It was considered to be rare previous to about 1945 but since then it has greatly increased in numbers. A similar population change has taken place in Tasmania (R.H.G. unpub. data).

Tasmanian Ring-tail *Pseudocheirus convolutor*. A few occur in the tea trees and eucalypts but nowhere are they plentiful. An adult male (1968/1/14) was found in a tree fern growing in the bottom of a deep gully in the Pegarah forestry reserve. The Queen Victoria Museum holds a spirit preserved female (1969/4/1) collected near Sea Elephant on 25 March 1963. The species was common about thirty years ago but suffered a decline which coincided with the increase in the numbers of brush-tail possums. A similar population change occurred in Tasmania about the same period (R.H.G. unpub. data).

Pigmy Possum *Cercartetus nanus*. Rare. McGarvie occasionally finds this animal at Egg Lagoon and in December 1967 found one drowned in a drum of water. The skull has been lodged with the Queen Victoria Museum (1968/1/33). An adult male (1968/1/36) was found near Camp Creek on 15 October 1967 and has been spirit preserved.

Tiger Cat *Dasyurops maculatus*. Though common in the days of early settlement no tiger cats have been seen on the island since 1923 and they are now generally believed to have died out. The settlers destroyed it at every opportunity because of its habits of killing dometic poultry and damaging the pelts of game animals by following snare lines and feeding on snared animals. This persecution, together with the severity of bush fires, no doubt assisted in its decline and eventual local annihilation. The last specimen was taken near Loorana by B. C. Heddle and its skin was sent to the National Museum of Victoria. This was not accompanied by the skull. The Queen Victoria Museum holds three skulls, 1940/163, 1943/105 and 1967/1/59, the latter specimen having been presented to the Queen Victoria Museum by Mr. G. R. Tatham. It had been collected by the donor's father about 50 years previously. Spencer and Kershaw (1910*a*) discuss the King Island tiger cat and also describe a larger subfossil species *D. bowlingi*.

Little Marsupial-mouse *Antechinus minimus*. Four were collected at the Pegarah forestry reserve in February, all as the result of their having been caught by a domestic cat. At dawn on the morning of 27 February a domestic cat was found with a subadult female (1968/1/13) which was still alive and active, though the fur was heavily soiled. The pouch was undeveloped and the nipples very small but the nipple complement was unmistakably six which is consistent with the Tasmanian subspecies *A. m. minimus* (Wakefield and Warneke 1963). On 28 February the decomposing carcase of

another subadult female was found on an access road near to the chief forester's residence and on 29 February two desiccated carcases (1968/1/7) were found in a dry drain in the same locality. When shown the specimens the chief forester stated that it was not unusual for his cat to bring home little animals similar to them. The locality was on the edge of the pine plantation and through it ran a semi permanent creek which created small swampy areas choked with a rank growth of weeds. Animals answering the description of this species have also been reported from the north of the island and from near Naracoopa.

Grey-headed Fruit-bat *Pteropus poliocephalus*. Morrison (1941) records this species from the state school at Currie and suggests it may be the first record from King Island. About 1938 Mr. Alf Button informed us that he found a large bat with a wing span of about two feet. Its wings had become entangled in the strands of a barbed wire fence at Pegarah and had died just prior to his discovering it. The specimen was not saved.

Lesser-long-eared Bat *Nyctophilus geoffroyi*. The collections of the Queen Victoria Museum includes one adult female (1964/1/50) collected on King Island on 12 April 1964.

Eastern Swamp-rat *Rattus lutreolus*. Common in many areas. An adult female (1967/1/61) was trapped in dense tea tree at Pass River on 13 December. The nipple complement was found to be eight which is in conformity with the Tasmanian subspecies *R. l. velutinus*. On 24 February two females and a male (1961/1/16-18) were trapped in coarse long grass growing in a bog at Pass River. McGarvie has found it living in the tall fescue grass at Egg Lagoon and Mr. Don Bowling collected a specimen (1969/1/3) in a swamp in the extreme south of the island.

INTRODUCED FOREIGN MAMMALS

Ship Rat *Rattus rattus*. Occurs spasmodically all over the island. Two males and a female (1968/1/8-10) were trapped at the Pegarah forestry reserve on 29 February. They were taken from a wet drainage area on the edge of the pine plantation and near to human dwellings. All were "greys" with grey belly fur.

European House-mouse *Mus musculus*. Common throughout the island.

Feral Cat *Felis catus*. A few occur throughout the island.

AMPHIBIANS

An account of the amphibians of King Island is given by Littlejohn and Martin (1965). A small series of amphibians was collected and observations were made in the course of the present study. All and only those species recorded by Littlejohn and Martin (1965) were collected.

Striped Marsh-frog *Limnodynastes peroni*. Heard calling from the verges of Pearshape Lagoon and other small ponds in that vicinity on 15 December. On 23 February it was heard calling during the night at Pass River. With the use of a flash light, the site was located in a weed bog and three (1968/4/4) were collected. Freshly laid egg masses were numerous and were well secluded beneath the weedy growth on the surface of the bog. They all consisted of unpigmented eggs as was found by Littlejohn and Martin (1965) and which is consistent with that laid by the species in Tasmania. A few were heard calling at Pass River and Yambacoona on 26

September. Templeton collected three (1970/4/3) from a drain on the Currie golf links in May 1970. Littlejohn and Martin (1965) found it only at Pearshape and Surprise Bay and considered it was restricted to the extreme southwest of the island.

Burrowing Marsh-frog *Limnodynastes dorsalis*. Heard calling from a small pond at Pegarah on 14 December and a pair in amplexis were collected (1967/4/11). A few were heard calling in September.

Brown Froglet *Crinia signifera*. Common and widespread. Specimens were collected at Pegarah on 14 December (1967/4/10) and at the forestry reserve on 29 February (1968/4/6). It was calling vigorously in all areas visited in September.

Smooth Froglet *Crinia laevis*. Five specimens (1968/4/2) were collected at Pegarah forestry reserve on 29 February.

Brown Tree-frog *Hyla ewingii*. One (1968/4/3) was collected at the Pegarah forestry reserve on 29 February.

Green and Golden Tree-frog *Hyla aurea*. Three (1968/4/5) were collected from an old disused sheep dip at Pass River on 22 February. In the same locality a small bulldozed waterhole, about fifteen yards across and carrying a growth of water weeds, was found to be inhabited by about 50 large specimens. At night and during the day they could be found resting on surface weed or the grassy verges.

REPTILES

An account of the reptiles of King Island is given by Rawlinson (1967) who lists five lizard and three snake species for King Island. In the course of recent visits to the Island Green made observations on the reptile fauna and collected a small series. Templeton has since collected additional material and lodged it with the Queen Victoria Museum. This included one additional species.

Rock Lizard *Egernia whiti*. Rawlinson (1967) lists only three specimens. These were collected at Naracoopa but he was unable to find it during his visit. The Queen Victoria Museum has since received an adult male (1968/3/13) collected at Boulder Point on 3 November 1968.

Southern Blue-tongue Lizard *Tiliqua nigrolutea*. A very large female (1968/3/4) was collected at the Pegarah forestry reserve on 26 February. It weighed 800 grams and had a total length of 460 millimetres. Upon dissection it was found to be carrying eight embryos (five left, three right) of an average length of 112 millimetres. The stomach contained remains of moths, beetles and the wing feathers of a small bird.

Tussock Skink *Leiolopisma entrecasteauxi*. A single specimen (1967/3/43) was collected at Pass River on 12 December. Templeton has collected it at Whistler Point and Loorana.

Three-lined Skink *Leiolopisma trilineatum*. One (1968/3/7) was collected at the Pegarah forestry reserve on 27 February.

Metallic Skink *Leiolopisma metallicum*. One (1968/3/6) was collected at Pass River on 23 February. Three *L. metallicum* were collected by Green on Albatross Island on 19 January 1960.

Small-scaled Skink *Leiolopisma pretiosum*. Templeton collected the first

specimen from King Island (1969/3/5) among rotting kelp in the littoral zone on Porky Beach on 30 March 1969. On 1 December he collected another five (1969/3/15) from the same site. One of these was found to be carrying four half developed embryos. Six were collected by Green on Albatross Island on 19 January 1960.

Copperhead Snake *Denisonia superba*. One (1967/3/42) was collected at Pegarah on 14 December and one adult female (1968/3/2) at Pass River on 20 December. One was killed near Pegarah on 28 September and upon dissection was found to have eaten several metallic skinks.

White-lipped Whipsnake *Denisonia coronoides*. One (1967/3/41) was collected at Pearshape Lagoon on 15 December and one adult female (1968/3/3) at Pegarah forestry reserve on 25 February.

Tiger Snake *Notechis ater*. Rawlinson (1967) lists this snake for King Island and gives literature records. He did not encounter it during his visit and Green similarly has been unsuccessful. McGarvie kills several in his garden at Egg Lagoon every summer. It has been collected on New Year Island and Christmas Island (Rawlinson 1967). When McGarvie visited New Year Island in February 1964 he found it very numerous and counted 58 in a period of four hours, some being up to six feet in length. The largest are mostly completely black and lack the transverse markings which are distinct in the smaller snakes (A.M.McG.).

FRESHWATER FISHES

Frankenberg (1967) discusses the galaxiid fishes and lists three species for King Island. The following material has been collected by M.T. Templeton.

Pigmy Perch *Nannoperca tasmaniae*. Pass River, 7 March 1970 (1970/5/11).

Common Jollytail *Galaxias attenuatus*. Porky Creek, 10 March 1970 (1970/5/9).

Spotted Mountain Trout *Galaxias truttaceus truttaceus*. Pass River 7 March 1970 (1970/5/10). Porky Creek 10 March 1970 (1970/5/28).

Cox's Mountain Trout *Galaxias coxii*. From a stream running into Porky Creek September 1970 (1970/5/29).

DISCUSSION

About 164 species of birds have been recorded from King Island and the adjacent waters. They include one introduced Australian and nine introduced non-Australian. Some of these records are doubtful. At least five bird species appear to have been locally exterminated by human predation or habitat alteration.

The Queen Victoria Museum holds about 260 specimens of 56 bird species, which have been collected on King Island (indicated (*)). An additional 100 bird species (indicated *) can be regarded as permanent residents or occurring with reasonable regularity. A number of species, not mentioned in this list (especially among the oceanic and wading birds) will undoubtedly be added by further observations and collecting.

In the opinion of the present authors, a total of 156 bird species (including one introduced Australian and nine introduced non-Australian)

can be listed positively as occurring on King Island or the adjacent sea. Eighty-one species of birds have been found breeding in the area (indicated B) and further investigations will probably produce additional records.

Of the fourteen endemic Tasmanian species listed by Ridpath and Moreau (1966), ten breed on King Island. This number includes the recently discovered Scrub Tit (not included by Ridpath and Moreau (1966) in the Bass Strait fauna) and excludes the Forty-spotted Pardalote which appears to have disappeared from the island. As with the Furneaux Islands (Green 1969), the only currawong on King Island is *Strepera fuliginosa*. In Tasmania this endemic bird favours the highland rainforests and its place in the lowland dry sclerophyll is taken by *S. arguta*. It is therefore interesting to find it occurring as the only *Strepera* in Bass Strait and living in a habitat inconsistent with that which it favours in Tasmania.

King Island appears to be the southern extremity of the distribution of several bird species. The Golden-headed Fantail-warbler was reported to be breeding at Springfield in north-eastern Tasmania in 1912 (Fletcher 1913). It has not since been recorded from Tasmania but is relatively common on King Island. The Dusky Moorhen, Masked Woodswallow, White-browed Woodswallow and Yellow-faced Honeyeater, none of which have been known to occur in Tasmania, recently have been found with considerable regularity. The Nankeen Night Heron, rarely seen in Tasmania, is a prolific local breeder and the Nankeen Kestrel likewise rare in Tasmania is regularly seen on King Island.

The mainland Australian influence is more pronounced than is the case with the Furneaux Islands, where the only species not recorded from Tasmania is the Dusky Moorhen (Green 1969). This is unexpected in view of the "stepping stone" islands between Flinders Island and Victoria, compared to the lack of such islands between King Island and Victoria and indicates that, over the relatively short distance involved, such "stepping stones" are of little significance. There are some noteworthy exceptions from the King Island avifauna. We have been unable to find any evidence of the Australian Pelican, yet it occurs round the Tasmanian and Victorian coasts, among the Furneaux Islands and breeds on Forster Island, north-east Tasmania (Green 1969) and on Penguin Island, north-west Tasmania, only about 56 miles south-east of King Island. Likewise the Cape Barren goose, which occurs in considerable numbers in eastern Bass Strait, normally is absent from King Island.

The Masked Owl, Eastern Rosella, Tawny Frogmouth, Owlet Nightjar, Scarlet Robin, Spotted Quail-thrush, Yellow-tailed Thornbill, Striated Field-wren, Southern Emu-wren, Little Wattle-bird, Noisy Miner, Beautiful Firetail and Grey Butcher-bird are not recorded. All are sedentary species which generally prefer a dry sclerophyll or heathland habitat. Except for the Scarlet Robin and Beautiful Firetail, they are also absent from Flinders Island (Green 1969). The predominance, among the sedentary birds, of wet sclerophyll-rainforest species as opposed to dry sclerophyll-heathland species (a phenomonen also evident among the mammals) is evidence that, at the time of recent isolation from Tasmania, King and Flinders Islands supported mostly wet habitat and its associated fauna. From Ridpath and Moreau (1966) this isolation took place at about 11000 years B.P. for King Island and 9000 years B.P. for Flinders Island. The subsequent changes in vegetation to its present form provided a habitat more suited to dry sclerophyll-heathland birds but those species not already present on King Island were then unable (or unwilling) to cross the water barrier. The Scarlet Robin and Beautiful Firetail may have used the "stepping stone" islands to Flinders Island. However it cannot be overlooked that the sedentary dry sclerophyll species occurring there have not flourished as might be expected, in their recently expanded environment. Some appear to have vanished and others are rarer than the closely related wet sclerophyll species which have now invaded the dry habitat.

Two typical examples of this are *M. validirostris-M. affinis* and *A. ewingii-A. pusilla*. In each case the former, wet sclerophyll, species is the most numerous. Whatever the reason for this, it is possible that it may also

have been responsible for the recent failure of *P. quadrigintus* and *A. tenuirostris*.

The Reed Warbler, a migrant to Tasmania from the Australian mainland, has never been found on King Island or Flinders Island. The absence of some wader and seabirds from the list is surely due, in part, to the lack of observers.

Several species have disappeared from the island since the arrival of white man. Most notable is the King Island Emu, the original occurrence of which is surprising in view of what appears by present standards to have been un-emu-like habitat at the time of isolation. However, from the little information available, it is apparent that the King Island Emu had evolved better suited to inhabiting thick bush than any of the other emu species; that is, smaller, stockier, with shorter legs and much less dependent on speed. Thus it may well have paralleled the evolution of the Cassawary in northern rainforests. The extinction of this bird undoubtedly was due to direct human predation. The early record of the Ground Parrot on Flinders Island (a species now absent, see Green 1969 no. 311) is further evidence of the presence at the time of isolation of wet sedgeland, a habitat occurring adjacent to rain forest in Tasmania and favoured by this parrot. This record could represent the last of a once greater population which disappeared from the Bass Strait islands with the gradually changing environment (Ridpath and Moreau 1966).

At least two Victorian species dependent upon eucalypt forest have disappered since the beginning of the last century apparently due to habitat alteration. They are the Red-tailed Black (or Glossy) Cockatoo and the Gang Gang Cockatoo, species which do not occur on the Tasmanian mainland.

The Eastern Spinebill is now very rare, if not locally extinct, and the Brown Thornbill has been found only once (see no. 475) since 1902. Both these species appear to have declined significally this century but neither predation or habitat alteration can be attributed directly as the cause.

Population increases have occurred among species favouring the open grassland. This is due directly to clearing and pastoral development, the Spurwing Plovers and Banded Plover being the most notable. Likewise the White-backed Magpie, introduced from Victoria about 1910, has since flourished with pastoral development and is far more densely populated today than it is in Tasmania, where it appears to have decreased during this century despite an apparently more suitable environment.

Almost without exception the introduction of non-Australian birds has resulted in their permanent establishment and a spectacular increase in numbers.

We have been unable to find breeding records of Grass Parrots, Swift Parrot, Woodswallows, Black-faced Cuckoo-shrike or Satin Flycatcher and these appear to be transitory migrants, as is their appearance on Flinders Island (Green 1969).

There is no recorded evidence that aborigines ever occupied King Island (pers. com. W. F. Ellis.).

During the winter and early spring of 1969 about 70 specimens, comprising 17 species of beachwashed sea birds were salvaged by Templeton on the west coast of King Island and sent to the Queen Victoria Museum (Templeton 1970). About half of these had a solidified oily substance adhering to their feathers. In some instances it did not appear to be sufficiently heavy to have been the prime cause of death but ingestion of the substance with food or when feather preening, may have caused death in some cases. Templeton informed us that he found some carcases almost completely encased in solidified oil These specimens and some Short-tailed Shearwaters and Little Penguins which also occurred in

the wreck were not salvaged and are not included in the above figures.

A similar wreck occurred at the same time on the east coast of Flinders Island (Green 1971) and several beachwashed prions were found near the mouth of the Tamar River with oil on their feathers. There has been no report from the region of live birds with oil impregnated plumage and deaths appear to have occurred at sea and the carcases later washed up on the beaches. The source of the oil has not been traced. The winter of 1970 produced fewer beachwashed birds in Bass Strait and except for one minor instance, oiling of the plumage was not discernible.

The recent acquisition and proclamation as a sanctuary of an area of 3800 acres near Lake Martha Lavinia to Sea Elephant, including the area known as The Nook (described under "Habitat") is commendable. It is ideal for this purpose and will be increasing value in the years to come. Big Lake, in the south, is a fine stretch of water with, good shoreline vegetation and adjoining swampland. This, together with some nearby lagoons, is used by many water birds as a breeding and feeding area and could provide an excellent water fowl reserve.

There are several small private sanctuaries on the island but, though these are well cared for under present ownership, their permanence is doubtful because of possible commercialisation under future ownership. The increase in land development and mining activities make it imperative to secure further reserves soon.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to Mr. M. T. Templeton, for his contribution to the knowledge of the island's fauna and for his many patrols to salvage beachwashed material, collect specimens and provide information. Also to Messrs. P. A. & R. G. Tatham, Mr. Jim Peterson and the Forestry Department, Mr. B. C. Heddle, Mr. A. McSweyn and all those residents of King Island whose interest and co-operation in this study has provided us with so much assistance. We also wish to thank Mr. John Courtney of Swan Vale, New South Wales, for making his observations available to us, Mr. T. E. Burnes for determining botanical samples, Mr. W. J. M. Vestjens and Mr. R. D. Barker for determining the gut contents and Mr. M. G. Ridpath and Mr.John Courtney for their helpful criticism of the manuscript.

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APPENDIX

The following list of gut contents has been compiled from King Island material. The date applies to 1968, except where otherwise stated. The samples listed may or may not include material taken from more than one bird.

Brush Bronzewing	20 February SAND SEEDS: 1 *Acacia* sp. 30 *Trifolium subterraneum* 6 *Sueda australis* 130 *Beyeria* sp.? 2 Cyperaceae
Brush Bronzewing	27 February GRIT 3 SEEDS: c. 400 *Trifolium* sp.
Eastern Swamphen	17 September 1969 Grass fragments
Green Rosella	26 February SEEDS: c.300 ? Euphorbiaceae
Green Rosella	26 February SEEDS: c.250 *Rumex* sp. c. 50 *Solanum* sp. c. 50? *Pimelea* sp.
Green Rosella	26 February SEEDS: c.300 ? Euphoribiaceae
Green Rosella	27 February SEEDS: c.2000 ? *Senecio* sp.
Fan-tailed Cuckoo	21 March remains 3 Elateridae (click-beetles) remains 8 Lepidoptera (moth) remains 3 Diptera pupae (fly-pupae) remains 1 Araneida (spider) remains 1 Chilopoda (small centipede)
Fan-tailed Cuckoo	23 February remains 1 Blattidae (cockroach) remains 1 Lepidoptera larva (caterpillar) remains c.20 Lepidoptera (small moth) remains 1 *Telephorus* sp. (soldier beetle)
Fan-tailed Cuckoo	27 August 1969 remains of hairy caterpillars Amycterinae (ground weevils) Mammal skin with hair.

Golden Bronze-Cuckoo	25 February remains of 9 Lepidoptera larvae (caterpillar)
Grey Fantail	21 February remains 2 Staphylinidae (rove-beetles) remains 2 Pentatomidae (shield bugs) remains 4 Muscoidea (flies) remains 2 Chrysomelidae; *Monochirus* ? *mutispinosus* (leafbeetle)
Satin Flycatcher	26 February remains 2 Cicadidae (cicadas) remains 2 Araneida (spiders)
Satin Flycatcher	27 February GRIT 2 SEEDS: 1 Liliaceae 102 *Acacia* sp.
Flame Robin	26 February remains of 6 *Telephorus* sp. (soldier beetles)
Dusky Robin	20 February traces only of Formicidae (ants) Scarabaeidae (chafers) Curculionidae (weevils) Orthoptera (grasshoppers)
Dusky Robin	20 February remains 1 Lepidoptera larva (caterpillar) remains 7 Tenebrionidae (blackbeetles) remains 2 Curculionidae (weevils) remains 1 Scarabaeidae (chafer beetles) remains 2 Carabidae (ground beetles) SEEDS: 1 unknown
Dusky Robin	21 February remains 1 Tenebrionidae (black-beetle) remains 2 Coprinae (dungbeetles) remains 1 Gryllacrididae (tree-cricket) remains 1 Lucanidae (stag-horn beetle) remains 1 Carabidae (groundbeetle) remains 3 Formicidae (ants) remains 2 Scorpionidae (scorpions) remains 1 Diplopoda (millepede)
Dusky Robin	27 February remains (traces only) Formicidae (ants) remains 1 Lucanidae (staghorn-beetle)
Dusky Robin	28 February remains 1 Carabidae (groundbeetle) remains 3 Curculionidae (weevils) remains 1 Lepidoptera larva (caterpillar)
Olive Whistler	20 February 8 GRIT + SAND remains 1 Curculionidae (weevil) remains 2 Cerambycidae (longicorn beetles)

	SEEDS: 2 Epacridaceae 1 Leguminosae 4 Unknown
Olive Whistler	22 February GRIT + SAND remains 1 Syrphidae (hover-fly) SEEDS: 6 Epacridaceae
Olive Whistler	26 February remains 1 Syrphidae (hoverfly) SEEDS: Unknown
Olive Whistler	27 February PLANT: 1 leaf fragment SEEDS: 6 Unknown
Olive Whistler	27 February remains of 12 Curculionidae (weevils) remains of 1 Blattidae ootheca (cockroach egg-capsule)
Grey Shrike-thrush	20 August 1961 remains 1 Phaladurinae (ground-weevil) remains 7 Curculionidae (weevils) remains 4 Pentatomidae (shieldbugs) remains 1 Dytiscidae (water tigerbeetle) remains 1 Hydrophilidae (a waterbeetle)
Grey Shrike-thrush	21 February remains of few small bird bones (unidentifiable) remains 3 Coprinae (dungbeetles) remains 12 Dermaptera, mainly *Forficula auricularia* (introduced earwig)
Grey Shrike-thrush	21 February remains 9 Dermaptera (earwigs) remains 4 Ichneumonidae (parasitic wasps) remains 2 Curculionidae (weevil)
Grey Shrike-thrush	22 February remains of *Hyla ewingii* Brown Treefrog
Grey Shrike-thrush	23 February remains Scincidae (remains skink lizard, some bone only) remains 2 Coprinae (dungbeetles) remains 2 Tettigonidae (longhorned grasshoppers) remains 3 Lepidoptera (moths)
Grey Shrike-thrush	26 February remains of Lepidoptera (moth) remains 3 *Iridomyrmex* (ants)
Black Faced Cuckoo-shrike	27 February remains 1 Lepidoptera (moth) remains 3 *Paropsis* sp. (leafbeetles)

	remains 1 Cerambycidae (longicorn beetle)
Black-faced Cuckoo-shrike	29 February remains 1 Lepidoptera (moth) remains 1 Curculionidae (weevil) remains 1 Hymenoptera (trace of wasp)
White-winged Triller	11 October remains 1 Noctuidae larvae (caterpillar) remains 2 Araneida (spiders) remains c.4 Lepidoptera (moths)
Australian Ground-thrush	21 February remains 1 small Dynastinae (chafer) remains 1 Curculionidae (weevil) remains 12 Elateridae larvae (click beetle) remains 1 Carabidae (ground beetle) remains 9 Diptera larvae (fly maggots) PLANT: c.40 ? Epacridaceae leaves
Australian Ground-thrush	23 February SAND remains 2 Coprinae (dung beetles) remains 2 Tenebrionidae (blackbeetles) remains 1 Elateridae Larva (click beetle larva) remains 2 Diptera larvae (fly maggots) remains Oligochaeta (earthworms) PLANT: 15 leaves Epacridaceae
Australian Ground-thrush	27 February remains 4 Elateridae larvae (clickbeetle-larvae) remains 1 Carabidae (groundbeetle) remains 4 Lepidoptera larvae (caterpillars) remains 1 Chilopoda (centipede)
Brown Scrub-wren	20 February GRIT 19 remains Curculionidae (weevils) remains 1 Blattidae ootheca (cockroach egg-capsule) SEEDS: 1 Chenopodium sp. 5 twig fragments 1 Cyperaceae 1 Roseceae
Brown Scrub-wren	22 February remains 4 Lepidoptera (moths) remains 1 Diptera larva (fly-maggot)
Brown Scrub-wren	25 February remains 1 Blattidae ootheca (cockroach egg-capsule) remains 2 Lepidoptera (moth) remains 1 Cerambycidae (longicorn beetle) SEEDS: 4 ? *Myosotis* sp. 1 *Epacris* leaf

Brown Scrub-wren	26 February GRIT 3 remains 1 Lepidoptera (moth) remains 1 Blattidae ootheca (cockroach egg-capsule) remains Isoptera (termites) remains 6 Formicidae (ants) SEEDS: 1 ? Euphorbiaceae 2 Leguminosae 2 fragmented seeds unidentifiable
Golden-headed Fantail-warbler	22 February remains 2 Pentitomidae (shieldbugs) remains 4 Tettigonidae (longhorned-grasshoppers)
Superb Blue Wren	20 February remains 2 Curculionidae (weevils) remains 19 *Iridomyrmex* sp. (ants) remains 2 Coprinae (dungbeetles)
Superb Blue Wren	22 February remains of 2 Curculionidae (weevils) remains 29 Formicidae (earwigs) remains 1 Lepidoptera (moth) remains 1 Diptera larvae (fly-maggot)
Grey-breasted Silvereye	22 February SEEDS: 18 *Rhagodia baccata* 1 *Solanum* sp.
Strong-billed Honeyeater	23 February remains 1 Lepidoptera (moth) remains 4 Araneida (spiders) remains 2 Telophoridae, *Telephorus* sp. (soldier-beetles) remains 1 Carabidae larva (ground-beetle larva) remains 1 Lepidoptera larva (caterpillar) remains 1 Tenebrionidae (black-beetle) PLANTS: 6 leaf fragments: Epacridaceae
Strong-billed Honeyeater	25 February remains 6 Blattidae ootheca (cockroach egg-capsules) remains 1 Lepidoptera (moth) remains 1 Formicidae (ant) remains 1 Cerambycidae (longicorn-beetle) remains 3 Araneida (spiders)
Strong-billed Honeyeater	26 February remains 1 Scarabaeidae (chafer) remains 1 Curculionidae (weevil) remains 37 Dermaptera *Labidura riparia* and *Forficula auricularia* (earwigs, the second species introduced)

Strong billed Honeyeater	26 February remains 4 Blattidae ootheca (cockroach egg-capsules) remains 3 Formicidae (ants) remains 4 Araneida (spiders) remains 2 Carabidae (groundbeetles) remains 1 Pentatomidae (shield-bug) remains 2 Lepidoptera larvae (caterpillars) remains 1 Chrysopidae larva (lace-wing larva) remains 1 Pseudoscorpionidae (pseudo-scorpion)
Strong billed Honeyeater	28 February remains 2 *Myrmecia* sp. (ants) remains 1 Blattidae ootheca (cockroach egg-capsule) remains 1 Diptera (fly) remains 2 Curculionidae (weevils) remains 2 *Papopsis* sp. (leafbeetles) SEED: 1 *Acacia* sp.
Yellow-throated Honeyeater	20 February remains 3 Lepidoptera (moths) remains 1 Araneida (spider)
Yellow-throated Honeyeater	27 February remains 5 *Telephorus* sp.(soldierbeetles) remains 1 *Paropsis* sp. (leafbeetle) remains 1 Curculionidae (weevil) remains 1 Buprestidae (jewelbeetle genus: *Stigmodera*)
Yellow-throated Honeyeater	27 February, 1967 remains 3 Curculionidae (weevils) remains 2 *Telephorus ? pulchellus* (soldierbeetle) remains 2 Cerambycidae (longicornbeetles)
Crescent Honeyeater	20 February remains 1 Diptera (Muscoidea) (fly) remains (trace) Lepidoptera (moth)
New-holland Honeyeater	20 February remains of 4 Araneida (spiders) remains 2 Ichneumonidae (parasitic wasps) remains 3 Curculionidae (weevils) remains 1 Lepidoptera (moth)
New-holland Honeyeater	21 October trace of Diptera (flies) trace of Coleoptera (beetles)
Yellow Wattle-bird	23 February remains 2 Ichneumonidae (parasitic wasps) remains 1 Coprinae (dungbeetle) remains 3 *Telephorus* sp. (soldierbeetle) remains 1 Bombylidae (bee-fly)

Yellow Wattle-bird	23 February remains 5 Apidae (bees) remains 1 Pentatomidae (shieldbug) SEEDS: 10 *Chenopodium* sp. 68 *Tetragonia implexicoma*
Black Currawong	15 December 1967 remains 1 *Paropsis* sp.(leafbeetle) remains 1 Scarabaeidae (chafer) remains 22 Curculionidae (weevils) remains c.56 *Paropsis* sp. larvae (leaf beetle larvae) SEEDS: c.200 Epacridaceae
Black Currawong	24 February remains 6 Gryllidae (crickets) remains 27 small Scarabaeidae (chafers) remains 2 Lepidoptera (moth) remains 2 Formicidae (ants) remains 2 Elateridae (clickbeetles)
Skylark	22 February remains 2 Acrididae (grasshoppers) remains 4 Formicidae (ants) SEEDS: 12 *Trifolium* sp. 1 Epacridaceae leaf GRIT c. 40
Californian Quail	22 February SAND: 14 *Geranium molle* 14 *Trifolium subterraneum* 1 *Vulpia* sp. 55 *Lolium perenne* 1 *Trifolium fragiferum* 1 *Trifolium dubium* c.50 ? *Teucrium corymbosum* 7 *Bromus* sp. 4 *Medicago lupulina* 7 *Trifolium* sp. 6 *Holcus lanatus*
Californian Quail	26 February GRIT 2 89 *Danthonia penicillata* 20 *Anagallis arvensis* 3 *Scirpus* sp. seedheads 28 Compositae flower heads (immature) 184 *Poranthera microphylla* 1 *Phalaris* sp.

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